Volume 2, No. 5 MAY, 1920 OLD SERIES, Vol. XVIII, No. 5

The Journal of Orthopædic Surgery

The Official Publication of the
American Orthopedic Association
and of the
British Orthopaedic Association

PUBLISHED ON THE FIFTH DAY OF EACH MONTH AT LINCOLN, NEBRASKA, U. S. A.
FOUR DOLLARS PER ANNUM
Entered as Second Class Matter in the Post Office at Lincoln, Nebraska

For the
British Orthopædic Association
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The Journal of Orthopædic Surgery

HABITUAL DISLOCATION OF THE SHOULDER JOINT

By Robert Ollerenshaw, F. R. C. S. (Eng.)

Hon. Surgeon and Surgeon in charge Orthopaedic Dept., Salford Royal Hospital. Surgeon Grangethorpe Special Military Surgical Hospital, Manchester.

Submitted to the British Orthopaedic Association, Nov. 1919

Habitual dislocation of the shoulder joint is a comparatively rare condition but cases are continually presenting themselves and in my own work, during the past year, I have met with four instances.

All of these have been given treatment of a conservative nature before I saw them but one of them had been operated upon. All four were young men engaged in active work and one of them was an epileptic.

Patient No. 1 was a very well developed man of 26 years, by trade a collier, but also a professional rugby footballer, whose left shoulder had first been dislocated in 1917 as a result of a "tackle" at football. The dislocation was reduced and his arm restrained in its range of movement for a month. The dislocation did not recur until 2 months later. From that time until I saw him in December, 1918, the joint had been dislocated on ten occasions.

The second case was that of an army pensioner, aged 27, whose right shoulder was first dislocated by a fall in 1912. Since that time the dislocation had recurred on 29 occasions.

The third patient, aged 28 years, had been subject to epileptic seizures since his 21st year and in June, 1918, his left shoulder became dislocated during an attack. He is accustomed to have about

one attack each month and the shoulder has dislocated with every attack since it first happened, eighteen times in all. The man complained little of his epilepsy as he had a light and safe occupation, but found the fixation of the arm and the necessarily restricted movement allowed after each dislocation to be a serious disability.

When admitted to hospital for operation this man arrived with the shoulder dislocated, having had an attack on the previous evening. The joint was radiographed before and after reduction.

The fourth case was a well developed man of 30 years who first had a dislocation of the right shoulder as a result of a fall from a ladder in 1915. Twelve months later during sleep the dislocation recurred and since that time he has had thirteen dislocations, the last being ten days before admission to hospital.

All these men were obviously in need of radical treatment.

The operative treatment of the condition has resolved itself into three methods. I purposely omit from serious consideration such operations as excision of the head of the humerus, gouging out the glenoid fossa and arthrodesis of the joint as being quite unjustifiable as primary measures in the treatment of this condition and based on a wrong idea of its pathology. The three remaining methods are:

1. Pleating the capsule.

2. Exsection of a portion of the antero-inferior aspect of the capsule and narrowing it by overlapping the edges.

3. The deltoid flap operation.

The first method has been followed, in some reported cases, by a permanent cure and on many other occasions by a recurrence. The second method, excision of a portion of the capsule, has been practised fairly extensively and it was strongly advocated by T. Turner Thomas of Philadelphia in 1914. This surgeon had operated upon 18 shoulders in sixteen patients and eleven of these had obtained good useful joints without recurrence after very adequate tests. Five cases, however, were followed by recurrence, some of them after two or more capsule operations. This method was adopted in the first of my four cases and has been followed so far by a perfectly stable joint although it is now nearly a year since it was performed and the man has worked as a collier since April, 1919.

In my opinion the muscle flap operation offers the best means of overcoming the tendency to dislocation because it provides, firstly, a good sling bracing up the head and neck of the humerus and, secondly, a muscular sling which contracts when the rest of the deltoid is in action, that is to say, in abduction of the arm, in which position the dislocation occurs. In 1909 Clairmont described a method of utilising a strip of deltoid in this way and reported two cases. Briefly the operation consists of two stages: the first is performed through an anterior incision splitting the deltoid and, by dividing the pectoralis major insertion downwards and separating the heads of the biceps, exposing the so-called quadrilateral space from the front. The space is opened up and enlarged downwards by dividing the upper edge of the tendons of insertion of latissimus dorsi and teres major downwards for three-quarters of an inch. The anterior circumflex artery is seen in the upper part of the wound and marks the upper limit of the operative field.

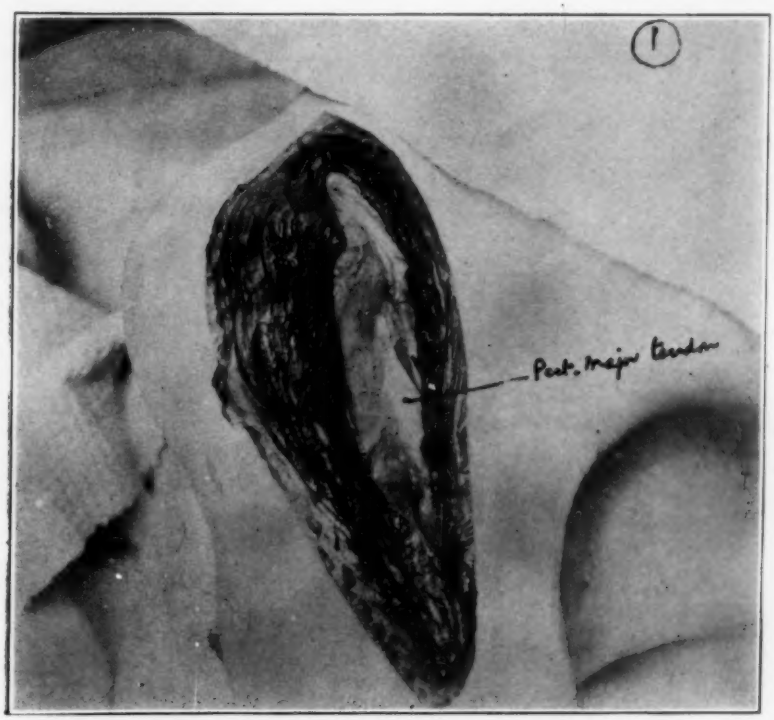

FIG. 1.

The patient is now turned on his side and the second stage takes place through an incision running parallel to the posterior edge of the deltoid and about one and one-half inches in front of this line. The deltoid is exposed and split along the line of the skin incision right down to its insertion and upwards as far as the point where the branches from the circumflex nerve enter its deep surface along with branches of the posterior circumflex artery. With this flap now turned well back the circumflex nerve and artery can be seen crossing in the upper part of the wound (Photograph No. 3). The origin of the outer triceps head is now exposed and its uppermost fibres separated downwards. This clears the space from behind so that there is now a channel for the passage of the flap. A long forceps is now passed through from the anterior wound and the point of the flap seized and drawn through. (Photograph No. 4.) According to Clairmont the flap is now to be sewn to the edges of the split deltoid in front, in the upper angle of the wound. The pectoralis tendon is repaired and the wounds closed.

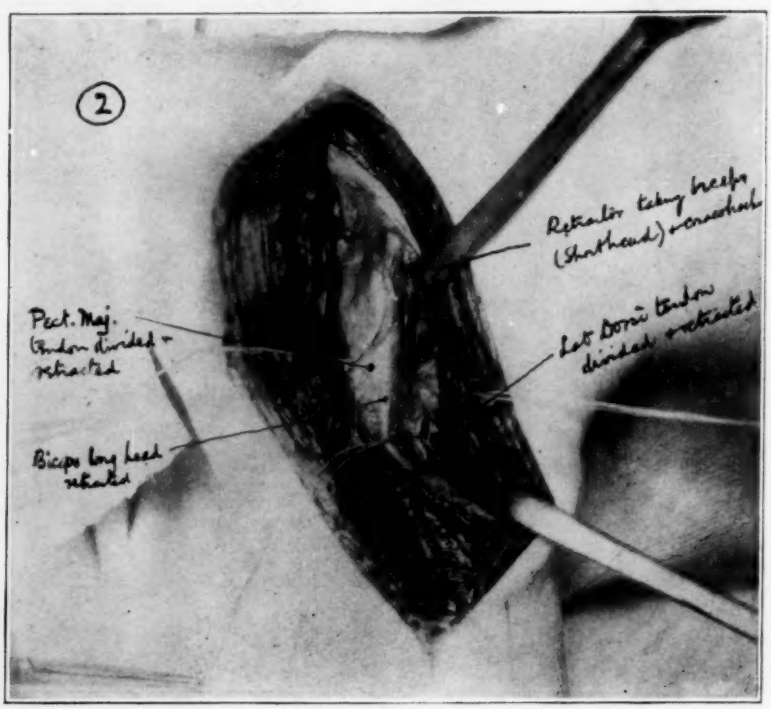
2
Retractor taking long head (short head) + muscle
Pect. Maj. tendon divided + retracted
Lat. Dorsi tendon divided + retracted
Biceps long head retracted

FIG. 2.

From my experience of the performance of the operation in the three cases now reported there are two points which require particular attention. The first one is with regard to the length of the deltoid flap. This must be as long as possible and, to ensure this, the muscle must be divided not merely as far as its tendon but right down to its periosteal insertion so that it may be sufficiently long to come well round the joint with no tension. The second point refers to the position to which the apex of the flap is to be sewn after being brought to the front. The suturing to the sides of the split deltoid as described by Clairmont, does not allow the flap to lie in such close apposition to the capsule as does fixation to the anterior surface of the subscapularis tendon. (Photograph No. 5.) This latter position also gives it a firmer attachment. The active slinging up of the joint when the deltoid flap

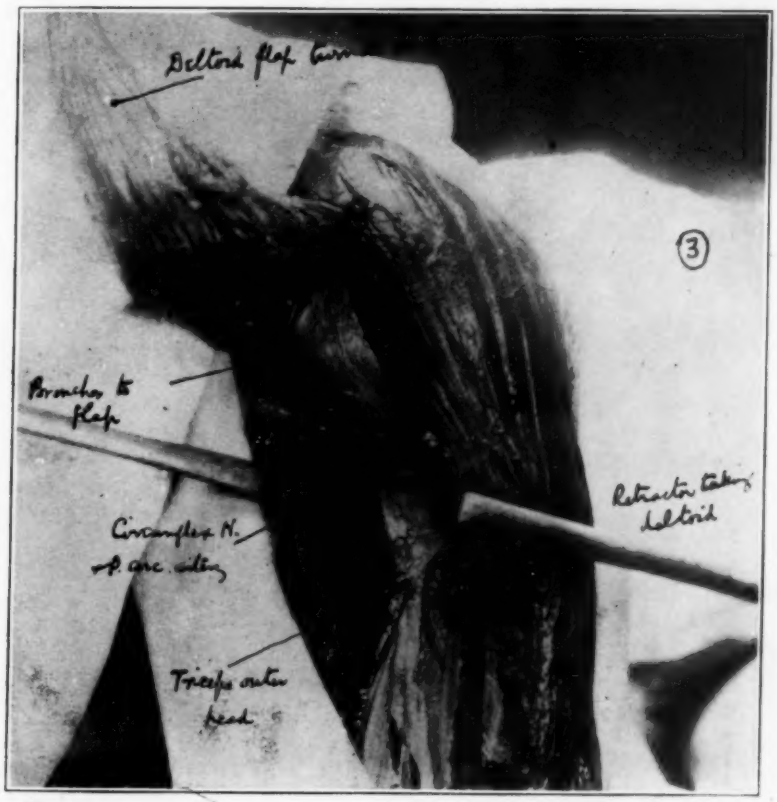

FIG. 3.

contracts can be well demonstrated at operation by direct faradic stimulation of the muscle after the suturing is completed. It is easy to estimate in this way the value of the transplanted strip of muscle. So far as I know this method has been tried very little in this country or in America.

Mr. Armour read a paper before the Liverpool Medical Society in 1914 in which he described two cases at which he had assisted Sir Robert Jones to perform the operation. The first of these operations failed as the dislocation recurred a few months later and the failure was considered by Sir Robert and Mr. Armour to be due to two factors—firstly, tension on the muscle flap and, secondly, too early active movement of the joint. It was considered that the flap had been too short and had torn away from its attachment and in this way its support had been lost.

The second case, an able seaman, whose shoulder had been dislocated 28 times, resumed his work four months after operation

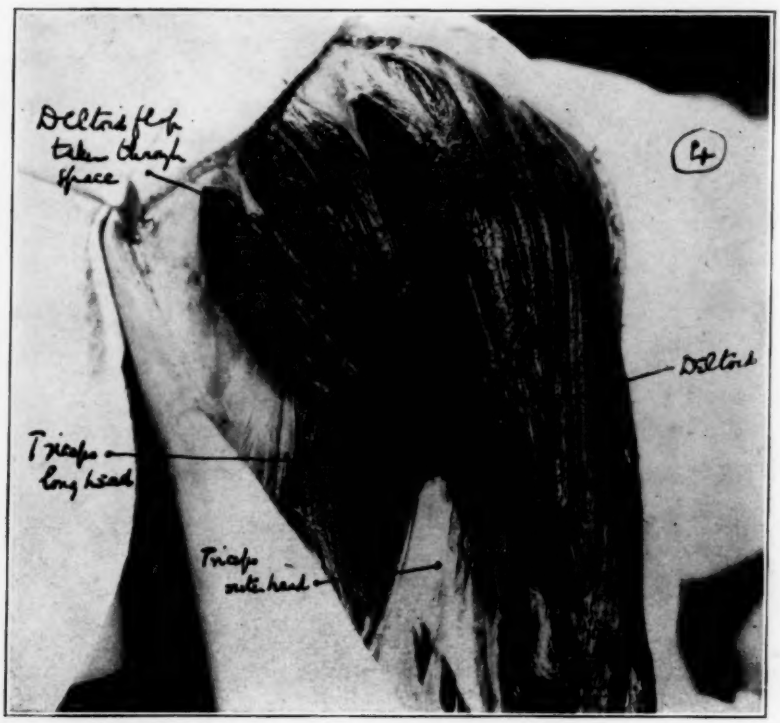

FIG. 4.

and has had no recurrence since. I know that both Sir Robert Jones and Mr. Armour have performed the operation since that time and I believe they have found it successful.

I have not allowed any of my cases to take the arm further than sixty degrees from the side until one month after operation and have then allowed gradual increases of active movement until at the end of two months there was a full range. With the epileptic I thought it wise to restrain his arm so that abduction beyond sixty degrees was impossible for two months after operation. All the patients expressed the opinion that the joint had a feeling of being braced which gave them confidence in using it. With regard to the pathology of the condition several of the cases reported by Thomas revealed at operation bony injuries of varying extent ranging from a detachment of a small fragment of joint margin to the separation of the anterior half of the glenoid, but Thomas regarded

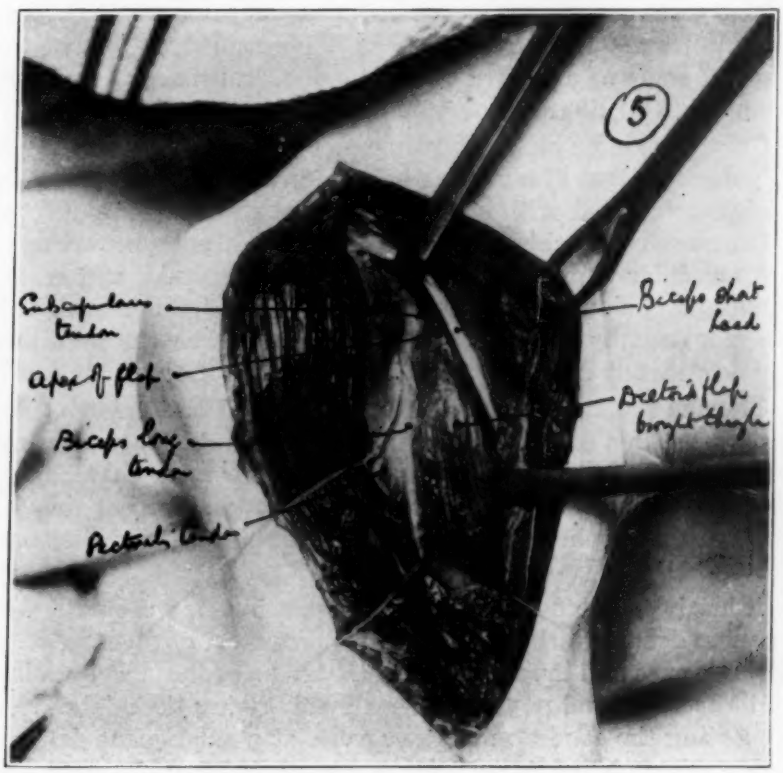

FIG. 5.

the recurrence of dislocation as being due to an enlargement of the joint capsule comparable to a hernia and spoke of the condition as a "hernia of the joint."

I am only able to state that in none of my cases was any bony change demonstrable by radiogram or at operation in either humerus or scapula.

Possibly small cartilage injuries, too small to be demonstrated without opening up the joint, may have been present but a careful palpation of the glenoid rim in each case showed no gross change in contour. In all of my four cases the capsule appeared to be lax but not markedly so in any of them.

In the fourth case there was a considerable prolongation of the synovial lining of the joint along the long biceps tendon, reaching down nearly as far as the upper edge of the pectoralis major tendon.

This distended process was, in its upper part, as thick as an adult little finger and tapered off as it descended; it bulged into the wound and was dissected off the tendon, transfixed in its upper part and tied off like the sac of a hernia.

I am of opinion that the recurrence of the dislocation is primarily due to a loss of muscular balance in the muscles controlling the joint, associated with a certain amount of capsule laxity, and that the most reasonable way of dealing with it is by providing an active muscular support which will come into action, and restore the muscular balance, in those positions of the joint in which the dislocation usually occurs. This method also has the additional advantage that it does not require opening up of the joint cavity.

Thomas found so much discharge of blood and synovial fluid after some of his operations that he advocated drainage as a routine measure after capsulorraphy. With our present technique these are no doubt small drawbacks to an operation but they are none the less loopholes through which trouble may occasionally arise.

It has been noted that several surgeons have, in the past, written papers dealing with this difficult subject, most of them referring to a single case and the further fact that none of these writers have contributed a second paper on the subject, giving their later views or reporting the condition of their cases at a subsequent date, has also been commented upon. All of my cases were operated upon

during the past year and so far there has been no recurrence in any of them, but I fully recognise that I am not yet entitled to refer to them as permanent successes. I intend to deal with any further cases by the muscle flap operation and at some future date I propose to report upon all such cases, including those referred to in this paper.

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DISCUSSION.

THE PRESIDENT: I think you will agree with me, gentlemen, that this is a very excellent thesis, and we can congratulate Mr. Ollerenshaw on his technique, and so far as time has allowed for these to be seen, the results of his operation It is a condition which is very disabling and distressing, and is well worth the comparatively severe procedure planned for its cure.

The subject is now open for discussion.

MAJOR DUNN (Birmingham): I have had the opportunity of seeing a good many of the operations for recurring dislocation of the shoulder. In my experience excision of a portion of the capsule or plication of it has not infrequently been followed by recurrence. In one case I remember in which this operation had failed—Clarimont's operation gave a good result. One case of recurrent dislocation of the shoulder on which I did a Clarimont's operation 15 months ago recovered complete free movement of the joint and was discharged 3 months later. The man was a farm laborer and promised to let me know if he had further trouble. I have not heard from him since.

MR. S. ALWYN SMITH (Cardiff): The last remark strikes me as bearing out the results of plication cases. I understood that if the results were good it was because the motion in abduction was limited and that if the movement was not limited to less than 60 degrees recurrence took place. Before I went out to France I had a case on which I was about to operate. I intended to supplement plication of the capsule by an operation to limit abduction at the shoulder joint beyond 60 degrees. This I intended to do by means of a strip of fascia lata extending from a hole drilled in the upper portion of the humerus, just below the circumflex nerve, to another hole drilled in the axillary border of the scapula. This fascial loop would effectively prevent abduction beyond the zone of safety. However, the war came on and the patient went to France where he was unfortunately killed in action in 1915. He was a well known ice hockey player and in one season he dislocated his shoulder on several occasions.

If the sling operation proves successful it should be better than limiting the abduction movement of the shoulder joint.

MR. BRISTOW (London): I have a case at Shepherd's Bush at present who is also an epileptic, and he has dislocated his right shoulder 18 times, and his left 16. I performed this operation on his right shoulder six months ago, and since that time he has had several fits and dislocated the left shoulder four times, but the right has not since gone out. It is of course far too early days to claim this as a success, but it is encouraging. Since then I have operated on the left shoulder as well. One point is, that by this operation you do not do

the man any harm. I did not have any trouble about it and he worked out his own salvation. I let him abduct in three weeks, and the right arm is as good as the other. There is no need to have the patient first on his back, then on his side. If you have the patient lying on his side with a sandbag under the scapula, you can keep him in the same position all through, and you can get the necessary exposure without difficulty. The difficulty that the flap of deltoid sometimes is not long enough, did not present itself in my cases.

What is the action of the deltoid afterwards? The fact that the slip of the deltoid contracts when stimulated with the faradic current on the table has no bearing on the function of the muscle, because if you cut a nerve and stimulate it, the muscle will still contract. The cortex and the higher centres do not deal with separate muscles, but with movements. What you actually do by this operation is to put a nice big lump of ragged muscle under the capsule, and the effect is to strengthen the part, and in addition as you will probably have some haemorrhage you will get still further strengthening by the formation of some fibrous tissue. I think that the results of this operation depend on the pad of muscle, rather than on any specific action of the transplanted slip.

MR. HARRY PLATT: I have done this operation once—five years ago. The result illustrates certain mistakes which are easily made. My deltoid flap was too short and thick because I did not divide the muscle close to its bony insertion. As Mr. Ollerenshaw has pointed out the flap should be thin in order that it may be pulled through the quadrilateral space easily. In my operation the result was successful in that there was no recurrence of the dislocation but the man who was a professional acrobat was unable to return to the stage. He had lost so much deltoid that his shoulder joint musculature was incapable of bearing the full brunt of his gymnastic manoeuvres. He entered the army but I believe in a comparatively low category.

MR. W. H. TRETHOWAN: I have no experience of this operation. I have opened only two cases of dislocation of the shoulder: one was the case of an officer at Shepherd's Bush, and the other a private case, a lady who had had a dislocation about every month for 18 months or two years. I agree with Mr. Bristow, if you cut off the nerve supply of the deltoid, it only acts as a bundle of fibrous tissue. I started to do it, but being sceptical, I plicated. In the first case I went below the subscapularis, and in the second one, above it. What interested me was the condition of the capsule. I expected to find a hernial sac, but there was a general distension of the joint, and one wondered why it dislocated. There is no local distension. Another matter was the great difficulty of plicating, and one doubted whether plication in these previous cases had been done well enough. Finally we got a fold ⅝ inch deep by digging up, keeping half-a-dozen forceps on. It was difficult to get good strong stitches in. Unless you plicate properly, it is useless to attempt it. I plicated them both—one twelve months ago, the other fifteen months ago. I have not heard that they have relapsed since. They are much too recent to base any valuable opinion upon. It is the difficulty of getting a fold which I think may have caused relapse in these cases.

SYPHILITIC AND TUBERCULOUS JOINTS

By Percy Willard Roberts, M. D., New York

During the past few years I have observed more than two hundred cases of chronic destructive joint disease with symptoms usually ascribed to tuberculosis which, from their behavior under mercury and potassium iodide, their suggestive family histories and the presence in many of dental stigmata, it is reasonable to believe were syphilitic. This material has yielded a number of interesting facts which were discussed at some length in an article published in the American Journal of Syphilis for April, 1920.

For the purpose of this communication the essential features of the deductions arrived at may be summarized as follows:

First, there was abundant confirmation of the opinions expressed many years ago by Gibley, Ridlon, Whitman, Sayre and others that cases of joint syphilis cannot be distinguished clinically from tuberculosis. My experience leads me to go further than this and to say that the symptomatology and radiographic findings of these two diseases is usually so nearly identical that to make a diagnosis of tuberculous joint disease without first eliminating the possible presence of syphilis invites serious error which jeopardizes the welfare of the patient.

Second, the Wasserman test upon which so much reliance is placed in the diagnosis, of acquired syphilis, is of comparatively little help in the late manifestations of inherited lues. In forty-seven cases where symptoms subsided under mixed treatment and where often there was a positive family history and other stigmata of lues, Wasserman tests made with an alcoholic antigen gave eleven weak positives and thirty-six negatives. The same bloods treated with cholesterinized antigens gave thirty-three positives from one to four plus and fourteen negatives.

Third, the medical treatment of cases of this nature does not differ materially from that of acquired syphilis. The cardinal points are to crowd whatever drugs may be used to the limit of tolerance and to continue treatment for at least a year after all symptoms have subsided. There are two great dangers of relapse. One is the premature abandonment of vigorous therapy and the other severe trauma. The latter is always a menace, as children may feel perfectly well and be apparently normal long before their bone lesions are completely healed.

Fourth, the orthopedic treatment of these cases varies somewhat from that usually employed in tuberculosis as the goal aimed at is quite different. In tuberculosis a firmly ankylosed joint is generally desirable as tissue regeneration is not to be expected. In syphilis, on the other hand, replacement of necrotic bone areas may occur with the restoration of practical function. Therefore weight-bearing joints should not be maintained indefinitely in plaster casts and the patient allowed to walk. Removable braces which will prevent weight bearing and allow motion in the joints when the patients are lying down are preferable. So, also, are removeable splints for the upper extremities, in order that voluntary motion at prescribed intervals may be carried out after the acute symptoms have subsided. Spine cases should, of course, be continuously immobilized until the radiograph shows solidification of the diseased bone.

In fifty-one of my cases a diagnosis of tuberculosis had been made by twenty-six surgeons, and had been under treatment for from six months to twenty-five years and yet all of them showed marked improvement under the use of mercury and potassium iodide and many of them became symptom free.

Brief outlines of five extreme cases, previously published, will illustrate the danger of ignoring inherited syphilis in considering a case of chronic destructive joint disease.

CASE 1. W. U. Previous diagnosis "tuberculous left elbow;" duration two years; joint ankylosed at a right angle; had been operated for abcess and lower end of humerus curetted. At the beginning of treatment the elbow was firmly ankylosed and a sinus had been discharging for two months. Four months later there was complete restoration of function. The Wasserman was negative, but the patient's sister, two years older, had a positive blood and three years later was sent to a hospital for the insane.

CASE 2. C. B. Age 8. Hospital diagnosis "tuberculous right knee;" duration of disease six years; previous treatment, continuous immobilization in plaster casts. At the beginning of medication the knee was stiff, swollen and tender and had about ten degrees of motion. A radiograph showed a large necrotic area in the head of the tibia involving the joint surface. Patient was given hydrarg. chlor, corr, gr. 1/32 and potassium iodide grs. x, three times a day. Three weeks later the pain and spasm had largely disappeared and there was voluntary motion to nearly a right angle.

Child has been symptom free for two years and radiograph shows practically complete bone regeneration. One Wasserman was negative and another weakly positive.

CASE 3. E. M. Age 14. Treated ten years for tuberculous knee, wearing plaster or braces all the time. Radiography showed necrotic areas in the head of the left tibia. When the patient came under observation the knee was enlarged and tender and had about ten degrees of motion accompanied by pain and spasm. She was given 1/32 gr. of hydrarg. chlor. corr. and 10 grs. of k. i. three times a day. The brace was continued two weeks, at the end of which time pain and swelling were considerably less and there was 80 degrees of joint motion. Brace removed and was not again worn. In three and a half months the patient was symptom free and had nearly normal joint function. Family history and Wasserman both positive for syphilis. A year later radiographic examination showed regeneration of necrotic areas in the head of the tibia. There has been no return of joint symptoms.

CASE 4. Age 20. Had been treated for tuberculosis of spine for fifteen years, having worn jackets and braces and had a bone graft inserted in the spinous processes, which did not take. He had been bed-ridden for a year and had seven profusely discharging sinuses. In ten weeks he was able to take long walks, three sinuses had closed completely and the others were discharging a small amount of thin fluid, and he had gained sixteen pounds in weight.

CASE 5. H. F. Age 31. Hospital diagnosis "tuberculous hip disease;" duration twenty-five years; active treatment for ten years; has had more or less pain ever since which was particularly severe for several months before he was placed on mixed treatment January 2, 1918. Nine days later the pain was very much less and the patient slept well for the first time in several weeks. January 23, 1918, the patient reported himself as symptom free. Two years later he reported that he had continued treatment during the interval and had been perfectly comfortable. He had never before known what it was to be well. His Wasserman was two plus.

AN UNUSUAL ABNORMALITY OF THE ELBOW JOINT

By Lloyd T. Brown, M. D., F. A. C. S.

This case is reported because it brings out the fact that the human machine may do its work for many years although in it there may be present an abnormality or a deformity which is the potential of much disability. This potential of disability may never be more than a potential until some circumstance occurs which causes an unaccustomed use or a strain and thereby starts the trouble going.

The patient was an athlete and had played college football and baseball and entered into all possible sports; baseball was his favorite game. At the time he was first seen, in March, 1916, he was a physical director in a N. E. State College. Nine months before this while running down a flight of stairs with a golf bag in his hand, he tripped, striking his right elbow on a cement walk. In spite of this injury he played 3 or 4 rounds of golf without any difficulty. Later in the day while throwing a baseball the right elbow suddenly "gave way as if it were paralyzed" and he has never been able to throw a ball with a snap to his elbow since that time. The arm has been gradually drawing up since the injury so that he has increasingly less motion. He continued his athletics during the fall, hurting it a few times while playing football and basketball. After these injuries the arm would be definitely worse and he would have less motion. He could always improve this motion by baking and massage.

Physical examination showed a big husky athletic man in excellent physical condition except that he was a little over-weight. Other than this the examination was negative except for the right elbow. The right elbow was negative to inspection. By palpation no thickening could be made out, and the bony land-marks were the same as on the other elbow. The motions were limited as follows: Extension to 150 degrees; flexion so that the hand could be placed just below the right ear. This limitation seemed to be due very largely to protective muscle spasm. There was no limitation of supination or pronation. An X-ray (See Figure 1) showed in the antero-posterior view, a large abnormality or spur formation of the inner side of the ulna at the joint line. This spur was so large that it overlapped and curved around the internal side of the trochlea surface of the humerus. At the tip of this spur was

a small bony mass which was not connected by bone trabeculae to the spur. There was also a slight amount of hypertrophic arthritis at other parts of the joint. The lateral picture was negative.

The patient could not give up the time for any operative procedure so a carefully fitted brace was made which would prevent either extreme flexion or extension.

The patient was next seen 6 months later when he said he had not been able to keep the brace in place because of the shape of his arm. The motions at this time were more restricted. Flexion was

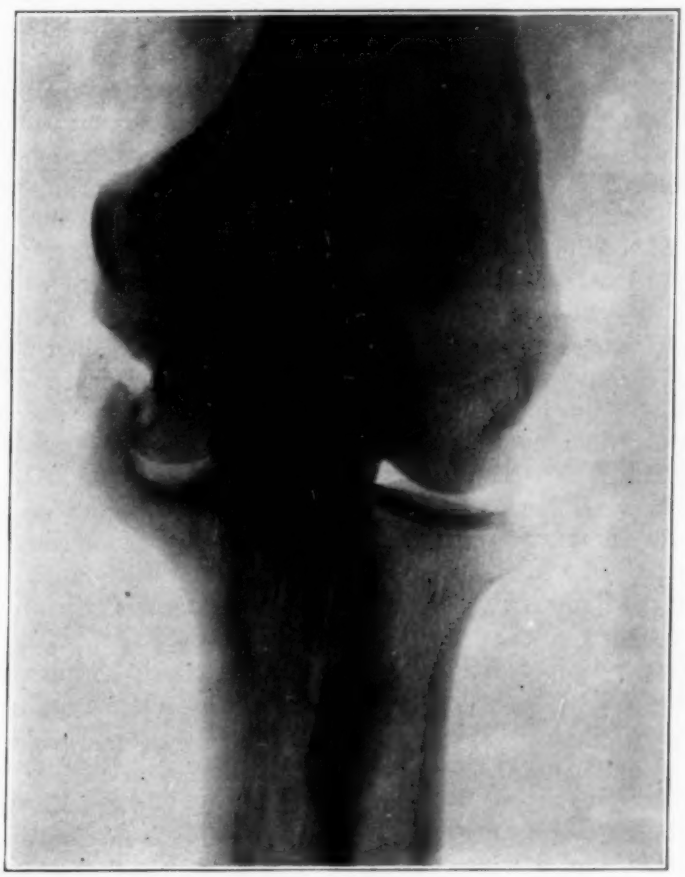

FIG. 1.—Anteor-posterior view before operation. Note the spur-like abnormality of the ulna.

limited to 75 degrees so that he could only with difficulty touch the lower end of his ear and extension was limited to 130 degrees. Because of his college work he could do nothing about his arm at this time. Four months after this the motion was still further limited. Flexion to 85 degrees and extension to 115 degrees.

This being the time when all the young men were enlisting the patient came again the following month, saying he wanted an operation because his elbow had made impossible any kind of enlistment.

In August, 1917, an operation was performed. Ether was used as the anaesthetic. A three-inch incision was made from the inner border of the olecranon down the shaft of the ulna. The olecranon bursa was found to be entirely absent and the tissue in this region was jagged and torn as if it had been severely bruised many times. The muscles and ligaments were then subperiosteally scraped off the internal condyle of the humerus and the olecranon, and the shaft of the ulna so that the abnormality was fully exposed. It was found to extend laterally upward toward the internal epicondyle of the humerus 1¼ inches, becoming smaller as it neared the upper end. At the base it was about ¾ of an inch wide. The abnormality was removed with an osteotome. About ¼ inch from the tip of it there was a cartilaginous mass about ¼ inch wide and ¾ inch long which extended into the joint between the coracoid process and the humerus. This mass definitely impinged in both flexion and extension of the joint. When this was removed the joint could be flexed so the hand touched the shoulder, and almost complete extension could be obtained. In making these motions some adhesions were broken. The part of the abnormality which articulated with the internal or lateral side of the trochlear surface of the humerus was covered with smooth and glistening cartilage. The trochlear surface where it articulated with the abnormality was likewise covered with smooth, glistening cartilage.

The periosteum and muscles were sutured together with catgut. The skin was sewed with silk-worm gut, and a large dry dressing and bandage were applied.

The convalescence was uneventful. In two weeks from the day of operation he had motion from 75 degrees flexion to 138 degrees extension. After baking this could be further extended to 160 degrees. In four months extension was possible to 170° and flexion to 45°. These angles were taken with a goniometer.

Figure II shows an antero-posterior view taken four months after the operation.

The latest report of the condition of the elbow was by letter dated March 15, 1920 and this said," My arm is as good as ever and think that it is practically straight."

As was stated at the beginning of this paper, the point of interest is not so much the abnormality which could be considered only a potential of trouble, as it had undoubtedly been present for many years without symptoms, but the fact that an injury which was not severe enough to cause an immediate disability, so impaired the ordinary mechanics of this abnormal joint, that the repeated slight injuries due to ordinary usage, caused enough irritation to increasingly limit the joint motion and function.

FIG. 2.—Four months after operation. Antero-posterior view.

OPENING REMARKS ON BIRTH PARALYSIS

By Harry Platt, M. S., F. R. C. S.

Hon. Surgeon and Surgeon in charge, Orthopaedic Dept., Ancoats Hospital, Manchester.

Orthopaedic Surgeon in charge, Grangethorpe Special Military Surgical Hospital, Manchester.

Paper read before the British Orthopaedic Association, November 14th, 1919, as part of the discussion on Birth Paralysis.

Mr. President and Gentlemen:

The subject of Birth Paralysis is one which in this country Mr. Fairbank has made peculiarly his own and it is therefore appropriate that our Association should have the opportunity of hearing his authoritative exposition on this important civil orthopaedic problem. Since 1913 there has been a marked revival of interest in Birth paralysis, particularly amongst orthopaedic surgeons.

I propose to limit myself today to a consideration of the diverse views which now exist concerning the exact nature and site of the lesion present in obstetrical paralysis and to indicate how far my own observations agree with or differ from the current conceptions; as a natural corollary I shall deal briefly with the question of treatment and especially with those points raised by Mr. Fairbank. My own work has been based on clinical observations made on a series of 23 cases of birth palsy which have been under my care during the past five years and also on experiments carried out in the Anatomical Department of the University of Manchester on the mechanism of the production of the lesion under consideration.

Pathogensis

Although in 1889 Kustner propounded a view that displacement of the upper humeral epiphysis was the underlying lesion present in birth palsy, the original conceptions of Erb and Duchenne of a supraclavicular lesion of the Brachial Plexus held undisputed sway until 1912. The operation findings of Kennedy of Glasgow and others seemed to maintain these conceptions beyond all doubt. Lange of Munich, impressed by the transient paralytic

phenomena in so many cases and by the secondary distortion of the arm seen so constantly, boldly claimed that here was a primary lesion of the shoulder joint capsule; he further stated that the paralysis was merely apparent and that there was no actual nerve trunk lesion. Turner Thomas of Philadelphia in 1914 adopted a similar explanation, except that he brought forward reasons in favour of a theory of the production of the shoulder joint injury in utero by the compression of the maternal pelvis. Turner considered that the paralytic symptoms were genuine and due to a temporary compression of the supraclavicular nerve cords by the exudate and scar tissue derived from the lacerated joint capsule. The evidence adduced by Thomas for the prenatal occurrence of the lesion is to my mind unsound and as I have already discussed this in a previous communication, I do not intend at the moment to deal with it in detail. About this time Vulpius revived the old theory of Kustner and avoided any explanation of the apparent paralysis beyond the statement that it was secondary and an unimportant feature in the clinical syndrome. We thus see the growth of two schools, one maintaining that all cases of birth palsy are primary lesions of the supraclavicular brachial plexus and the other, that all cases are primary lesions of the shoulder joint capsule or upper epiphysis of the humerus. Peltesohn adopted a via media and after a careful study of 11 cases distinguished two groups—true and false paralysis. The true paralysis were characterised by the absence of contractures, the presence of free mobility, and the occurrence of definite paralysis and wasting of the muscle group concerned. In the false palsy cases he noted the absence of true paralysis and muscle atrophy, and the presence of fixed contractures; in these latter cases radiograms showed definite evidence of displacement of the upper epiphysis of the humerus. Peltesohn considers that the displacement of the epiphysis at a later stage forms an undue posterior projection under the acromion, thus explaining the physical sign noted originally by Whitman and regarded by most observers as a subluxation of the shoulder joint secondary to the paralysis. Van Neck from a study of 14 cases has distinguished 4 groups:

(a) True paralysis, 3 cases.
(b) Shoulder joint torsion, 2 cases.
(c) Epiphysial lesions, 5 cases.
(d) Congenital deficiencies in the Brachial Plexus, 4 cases.

He states that true paralysis always leads to the development of contractures, thus maintaining a view exactly opposite to that of Peltesohn. The epiphysial lesions noted by Van Neck included separation of the upper epiphysis of the humerus and intra-epiphyseal fractures, both lesions being recognisable in good radiograms. This author further points out that in the new born infant the differential diagnosis between these different types of lesion is impossible; this statement will, I think, be subscribed to by most observers.

Sever in 1916 collected all reported cases of birth palsy up to date and in addition to emphasising the frequent occurrence of subluxation of the shoulder, repeated the original experiments of Clarke, Taylor and Prout who in 1905 had studied the effects of violent traction on the head in the infant cadaver. Sever's observations left him in no doubt as to the occurrence of a supraclavicular lesion of the brachial plexus in all cases of birth palsy but he recognised the tendency towards spontaneous recovery of the paralytic signs. Ashhurst in a very able paper last year, concluded that supraclavicular lesions of the brachial plexus do occur but are infrequent, and that most cases of birth palsy are "terminal" nerve lesions and depend on a co-existent shoulder joint capsule injury, the muscles paralysed being those supplied by nerve trunks or branches in close proximity to the joint: namely suprascapular, circumflex, musculo-spiral and musculo-cutaneous nerves. Furthermore Ashhurst declares that the nerve lesion in birth paralysis requires no operative repair.

We have traced the evolution of these conflicting views in some detail because it is surely obvious from a practical standpoint that we, as orthopaedic surgeons, must have a working hypothesis in dealing with these cases and particularly in our teaching. As adherents of the classical theory we may quote Sharpe of New York, who reported in 1916, 56 plexus operations performed in a very short period, and recommended the routine exposure of the brachial plexus at the age of one month in all cases of obstetrical palsy. Taylor, in 1913, reported 43 personal operations on the plexus and also recommended early exploration in young infants owing to the fact that in his opinion spontaneous recovery is uncommon. There is a vast gulf between the conceptions of a primary shoulder joint injury which requires correct postural fixation only to bring about restoration of function in the limb, and a

brachial plexus lesion demanding operative exploration in all or most cases. We thus have to decide whether all cases of birth palsy are due to one type of lesion or if several distinct lesions can be included under this heading. If this latter conception be true we require knowledge upon which we can base a differential diagnosis between the various types. Before considering the evidence for and against the various theories I shall briefly present an analysis of the cases which have been under my observation during the past 5 years.

Analysis of Personal Cases

Of the 23 cases all showed a unilateral affection, the left arm being involved in 13 and the right in 10. A history of difficult labour was present in all but my statistics of the actual presentations are incomplete; in 10 in which I elicited this information 8 were vertex and 2 breech presentations. In 10 instances the child was unusually big, 4 of the infants weighing at birth 14 lbs., 13½ lbs. and 11 lbs. respectively. In 4 cases in addition to the birth palsy symptoms there were associated injuries: a sterno-mastoid haematoma in one case and a fracture of the humerus in 3. The cases in this series may be divided for the purpose of study into 4 groups according to the condition presented at the time of examination.

Group 1. 12 Cases.

In the patients in this group the actual paralysis had recovered and the patients presented the typical subluxation of the shoulder joint with a fixed internal rotation contracture of the arm. The characteristic physical signs were the perfect contour of the limb with the absence of any localized muscle atrophy, the mechanical disablement due simply to the torsion and the general under-development of the limb in length and calibre varying according to the length of time the disability had existed. Spontaneous recovery had been noted by the parents in all these cases; some had received no treatment at all, others had attended hospitals anad undergone a certain amount of massage. In all cases the arm had been bandaged close to the side after birth and maintained in this position for some weeks. No patient had been splinted in what we know to be the correct posture. The problem of treatment in this group was solely that of the contracture and not of a paralysis.

GROUP 2. 6 CASES.

The cases in this category showed a typical subluxation of the shoulder joint combined with a residual paralysis affecting the extensors of the wrist, fingers and thumb. There was no evidence of existing paralysis or muscle atrophy in the upper arm muscles which had obviously undergone spontaneous recovery. One may note that the paralysis of the extensor group of muscles recovered under postural treatment in 4 out of the 6 cases.

GROUP 3. 3 CASES.

CASE 1. A baby of nine months presented a very flail limb in the usual position of full internal rotation and with a complete paralysis of the deltoid, spinati, biceps, supinators, triceps and extensors of the wrist, fingers and thumb. In addition to the general under-development of the limb there was a slight definite flattening of the contour of the deltoid, triceps and biceps-true localized muscle atrophy. In this patient the position of internal rotation was accompanied by a slight limitation of the range of passive external rotation and there was a distinct bulge of the head of the humerus posteriorly although the difference in the two sides was barely appreciable. I should like to comment on this case that with a severe existing paralysis which so far had shown no signs of recovery there was an internal rotation contracture and an early subluxation of the shoulder joint.

CASE 2. A child of 6 weeks with simple wrist drop noted the day of birth after a difficult and prolonged labour; there was here absolutely no evidence of any disability in the upper arm. This patient after one month's treatment on a cock up splint showed manifest recovery and seen two years later showed no evidence of any disability. This is not a typical case of birth paralysis as ordinarily understood but nevertheless was a definite paralytic phenomenon occurring after a difficult labour.

CASE 3. A baby of 4 months seen with the typical posture and an apparent upper arm type of paralysis with no contracture or subluxation, after 4 months fixation on a splint in the standard posture of relaxation showed commencing recovery in the deltoid. Two years later he showed complete recovery of the paralysis but with a slight internal rotation contracture un-accompanied by any posterior subluxation of the head of the humerus.

GROUP 4. 2 CASES

Both patients who were older children, age 13 and 18 respectively showed exceedingly flail limbs.

CASE 1. In this child the right arm was profoundly wasted and under-developed, resembling very closely the condition seen in anterior poliomyelitis. There was a complete paralysis of the deltoid, spinati, rhomboids, serratus magnus, biceps and intrinsic muscles of the hand. The shoulder joint was flail and showed the usual downward subluxation of the head of the humerus. The clinical syndrome in this patient indicated without doubt a lesion of the brachial plexus high up above the origin of the nerve supply to the serratus magnus and rhomboids; that is to say a radicular lesion and for practical purposes almost intra-vertebral and therefore to my mind inoperable. In this patient I performed an arthrodesis of the shoulder treating it in the manner comparable to that used for the similar disability following infantile paralysis.

CASE 2. This patient, a girl of 18 with a history of difficult labour and paralysis of the left arm noted immediately following birth, showed profound atrophy and lack of development in the left upper limb with a flail shoulder and wrist joint. The only muscles acting in the limb were the deltoid, pectoralis major, biceps, supinator longus, extensors of the fingers and superficial and deep flexors. In this patient I explored the plexus above the clavicle, but without any definite hope of being able to effect direct operative repair. It is interesting to note that there was no trace of any lesion in the supraclavicular triangle, the nerve cords being intact but small and on stimulation giving results identical with the clinical findings. It was obvious in this case that the lesion was high up close to the origin of the nerve roots from the cord and therefore inoperable.

The two patients in this group are exceedingly interesting as flail limbs following birth paralysis are very rarely seen in older children or adults. This has been commented on by several authors and I would suggest that where recovery of the paralysis fails in cases of birth palsy the lesion will be in many cases a lesion of the cervical roots high up above the actual formation of the plexus proper.

I would sum up the points of importance noted in my series of patients as follows:

1. Out of 23 cases, 19 developed the internal rotation contracture of the arm and the posterior subluxation of the shoulder joint. In 18 of these cases the paralysis of the deltoid group recovered spontaneously; on the remaining patient I have no recent observations as the child whilst still under treatment, left the country.

2. In two patients seen many years after the injury a very flail limb with severe muscle wasting as in poliomyelitis, was present.

3. Two cases of simple uncomplicated paralysis showed recovery under correct postural treatment. This brings the number of cases of spontaneous recovery of the paralytic signs to 20 out of 23. I would emphasize once more the tendency towards spontaneous recovery of the paralysis and secondly that the posterior subluxation and the internal rotation contracture of the arm dominates the whole clinical picture of obstetrical palsy.

Discussion of the Theories of Causation

Evidence for the Supraclavicular Plexus Injury Theory.

There can be no doubt that in some cases of birth palsy there is a lesion of the brachial plexus above the clavicle. The evidence on which this is founded is derived from operative, experimental and clinical observations.

(*A*) *Operative Exploration.*

The operative findings of Kennedy, Taylor and Sharpe and others have revealed in the cases explored, lesions of the plexus at or about the junction of the fifth and sixth anterior primary divisions of the cervical nerves. The operation findings quoted by Mr. Fairbank in opening the discussion correspond to those of the authors above named.

(*B*) *Experimental.*

Clarke, Taylor and Prout of New York in 1905 attempted to reproduce on the cadaver lesions of the brachial plexus which were said to be characteristic of birth palsy. These authors found that traction on the head with a fixed shoulder caused the nerve cords in the neck to become taut; on increasing the traction force the uppermost cord was found to fray out or snap; still further force

acted on the lower cords, the degree of tension diminishing from the upper to the lower cords. Laceration of the deep cervical fascia occurred in all experiments in which considerable violence was used.

From these results it was found that 80 per cent of the lesions produced were above the junction of the fifth and sixth cervical anterior primary divisions.

Sever repeated these experiments in 1916 and found that very considerable force was needed to cause rupture of the fifth and sixth cervical nerves; the supraclavicular nerve usually snapped before any other, but in most cases it was found that the nerve sheath only gave way, the nerve bundles proper fraying out inside the sheath without undergoing complete laceration. Sever noted that in order to place extreme tension on the lower cords abduction and elevation of the arm was necessary, thus presupposing a different type of violence for the birth palsy in which the paralysis could be explained by a lower cord injury. Sever was unable to produce a rupture of the shoulder joint capsule, separation of the upper epiphysis or dislocation of the humerus, but found that methylene blue injected into the shoulder joint diffused out through the anterior capsule when this had been divided. The dye percolated into the axilla and surrounded the plexus branches at this level. This latter experiment was carried out in order to refute the view of Turner Thomas who supposed that an exudate from the shoulder joint capsule would travel above the clavicle and therefore produce compression of the nerve trunks at this level.

I have recently been able to carry out similar experiments on still born full time foetuses in the Anatomical Dept. of the University of Manchester, owing to the courtesy of my colleague, Professor J. S. B. Stopford. The foetuses were used fresh without a preliminary injection of any preservative in order to avoid undue shortening or hardening of the soft tissues. All varieties of violence embodying the manoeuvre of separation of the shoulder from the head were employed both before exposing the plexus and after. I found that with the greatest separation between the head and the shoulder there was considerable tension on the fifth, sixth and seventh anterior primary divisions. The suprascapular nerve was not, however, rendered tense before the fifth and sixth nerves.

After division of the clavicle with the free mobility of the shoulder joint now possible I failed to rupture any cord in any

experiment. With regard to the rupture of the sheath and fraying out of the nerve fibres I must say that in these tiny infants it is difficult to recognise macroscopically a lesion of this type. On the closest inspection I was unable to see any evidence of sheath rupture. When the head is flexed laterally and rotated to its point of maximum separation from the shoulder one notes that the transverse processes of the cervical vertebrae are rotated forwards and the scalenus medius mass forms a marked bulge in front. This suggested the possibility of the point of injury of these nerve roots being at the level of the transverse processes, but I could not produce any naked eye lesion at this level. In one instance I caused a rupture of some blood vessels in the intervertebral foramen from which the fifth nerve emerged; the effusion from these vessels trickled down for some little time along the course of the fifth nerve and upper trunk. This occurrence is interesting and perhaps suggestive, but I do not intend to dilate on its potentiality. With regard to the deep cervical fascia I did not note any tearing in any of my experiments. When the maximum point of separation of the head and shoulder has been obtained further violence can be inflicted by traction on the arm. This produced considerable tension on the anterior-inferior portion of the capsule of the shoulder joint, the head of the humerus dropping a little. With excessive force I was unable to produce any dislocation of the shoulder joint, separation of the epiphysis or in fact any demonstrable lesion of the shoulder joint capsule. In this last manoeuvre the position of the circumflex nerve as it runs in contact with the lower part of the shoulder joint capsule suggested its vulnerability. The results of these experiments are on the whole negative and one cannot place too much reliance on their applicability to the actual lesion in the living child. From my own observations it is clear that extreme violence only will produce an actual rupture of the nerve trunks and it seems to me that the point of location of the lesion is likely to be high up, either in the spinal roots proper, in the anterior primary divisions before junction or on the other hand in the terminal branches of the plexus in close relation to the shoulder joint.

(*C*) *Clinical Evidence*

The posture of the arm at birth and the immobility have been explained for a long time as due to a paralysis of the group of muscles supplied by the fifth or fifth, sixth and seventh cervical

nerves. I think we must admit that in young infants immobility alone is not a conclusive proof of true paralysis due to a nerve lesion and certainly not of any one localisation of the supposed nerve lesion. The distribution of the paralysis of the upper arm type of case can be explained equally well by the assumption of a nerve lesion in the axilla in close relation to the shoulder joint. This has been maintained by Ashhurst and I think is a view which requires very careful consideration. In cases where rapid spontaneous recovery occurs especially before the patient is seen by the surgeon it is as logical to assume the existence of a previous infra-clavicular nerve lesion as to assume that of a supra-clavicular lesion. It is in cases where recovery is slow or occurs not at all and particularly where certain muscles show definite paralysis which are supplied by branches arising high up from the plexus that the existence of a supraclavicular lesion is established beyond all doubt. In the same way the pupilary changes noted in a few cases of the lower arm type of paralysis shows the location of the lesion again to be radicular. From a practical standpoint it does not matter in a recovered case whether the site of the lesion is definitely proved, as the proper treatment is that of the contracture of the arm.

(2) *Evidence for Primary Shoulder Joint Lesion*

The posture of the limb in the early stages, the occurrence of a subsequent contracture, the transient paralysis in muscles supplied by nerves in close proximity to the joint capsule, theoretically, can be explained by the assumption of a shoulder joint lesion. We must admit that the bulk of the evidence in favour of the shoulder joint lesion is evidence of a negative type and is based on reasons against the adoption of a supraclavicular plexus lesion for all cases. With regard to the posterior subluxation of the joint which as a clinical phenomenon is an undoubted fact, it is not difficult to explain this sign if a shoulder joint capsule injury be presupposed. Laceration of the antero-inferior part of the capsule by violent traction and torsion of the upper limb would provide all the factors necessary for the production of the fixed contracture and of the slow forcing back of the head of the humerus by the cicatrizing tissue. The actual confirmation of a shoulder joint lesion from operative exploration is, however, lacking. In my own experience of the open operations performed for relief of the sub-

luxation I have seen no signs pointing to the occurrence of a previous laceration of the joint capsule in this region. We may reasonably state that the shoulder joint theory is purely a theory, but is a feasible one and is a satisfactory explanation in a certain proportion of cases of birth palsy.

(3) *Evidence for the Epiphysial Theory.*

The occurrence of epiphysial injuries in cases presenting the clinical syndrome of birth palsy should be possible of proof by radiography. The evidence of most observers is against the frequent occurrence of epiphysial injuries as birth traumata. In my own series of cases the radiograms of the shoulders have shown no changes indicative of an epiphysial injury.

The radiography of small infants is not always a satisfactory procedure and the changes described by Van Neck and Peltesohn are rather meticulous. It is fair to assume that the evidence in favour of pure epiphysial lesions presenting the clinical picture of birth palsy is wanting.

I think that Ashhurst has exaggerated the infrequency of supraclavicular lesions of the plexus but the view that a primary shoulder joint injury with a transient nerve lesion in the neighbourhood of the shoulder joint can explain certain cases of birth palsy is, I think, reasonable. One cannot be dogmatic at the present time, but I would conclude by stating that there is a certain amount of evidence in favour of including under the heading of birth palsy, two distinct groups of lesions.

TREATMENT

Early Stages. As the evidence available is in favour of the occurrence of spontaneous recovery in the vast majority of cases, the early treatment should be conservative. The limb should be fixed in the standard position of relaxation for a prolonged period. I have little doubt that if this were adopted in every case there would be few cases which show no recovery of the paralytic phenomena, and no case would develop the internal rotation contracture and posterior subluxation of the shoulder joint. With regard to the question of exploration of the plexus, it has been suggested by Mr. Fairbank that if no recovery is manifest in the deltoid group at the end of three months and if the reaction of

degeneration be elicited, the plexus should be explored. I would say dogmatically that the minimum period of one year should be given for conservative treatment, providing that during this period the correct posture is maintained.

I think the extensive experience in peripheral nerve injuries which has fallen to our lot in the past five years has taught us that brachial plexus injuries should be treated conservatively for long periods and that the reaction of degeneration is an unreliable criterion of the existence of a complete nerve block or the inability of a nerve to undergo spontaneous recovery of function.

The technical difficulties of testing the electrical reactions in infants are very much greater than in adults and conclusions drawn from the readings still less reliable. I would suggest that before the supraclavicular plexus is explored in a case of birth palsy there should be in addition to complete paralysis of a muscle group which has persisted for more than 12 months, definite wasting such as is seen in true complete nerve injuries. Where the clinical symptoms indicate a lesion in the region of the intervertebral foramina, I hold that this type of case is inoperable from the point of view of nerve repair and that the resulting disability should be treated by the appropriate procedures such as are used for the residual paralysis of poliomyelitis.

Later Stages

In 17 cases in which I have operated for the relief of the posterior subluxation, in six cases reduction was effected by manipulation and in eleven by the open operation introduced originally by Mr. Fairbank. The functional results on the whole in my own cases have been disappointing; this has been due to the lack of consistent after treatment. In hospital patients spontaneous recovery and increased use in the arm always persuades the parents that no further supervision is needed. When reduction can be achieved by manipulation it is wise to maintain the fixation in plaster for a considerable period; I would say as long as 6 months, as relapse is exceedingly common. After the open operation the period of fixation should be as short as possible—six to eight weeks—as there is a great tendency for cicatricial contracture in and around the shoulder joint capsule. The position I adopt after reduction of subluxation is the standard position of 90° abduction and full

internal rotation. After treatment must be carried out over a prolonged period until the child has full active power of external rotation at the shoulder as there is a danger of the contracture returning.

DISCUSSION.

MR. H. A. T. FAIRBANK opened this discussion by reading the following paper:

REMARKS ON BIRTH PALSY.

BY H. A. T. FAIRBANK, D. S. O., O. B. E., M. S., F. R. C. S., LONDON.

Birth Palsy may be defined as paralysis, usually partial, of the upper limb, the result of injury during birth. In the large series of 471 cases published by Thomas and Sever, the sexes are equally affected, while the right arm was rather more frequently affected than the left in the proportion of 3 to 2.

Labour has usually been difficult, though the paralysis sometimes follows normal labour. Head presentations are recorded much more frequently than breech, in the proportion of nearly 4 to 1.

The early *theories* of the paralysis being the result of direct pressure have been generally discarded in favour of the "traction theory." The supporters of this theory believe that the damage is done by stretching of nerves of the brachial plexus by forcible separation of the head from one shoulder during delivery, or by direct traction on the arm.

Two other theories call for consideration.

In the first, the damage to the shoulder joint is regarded as the primary lesion, and the paralysis as secondary to it. The nerves are said to be damaged either by direct pressure of the displaced humerus (Delbet and Cauchoix)—this theory places the lesions in the terminal branches of the plexus—or by involvement of the plexus in scar tissue formed by the organization of blood that has spread up from the damaged joint capsule. (T. T. Thomas.)

The second theory is that the nerves and the joint are both primarily damaged at birth. (Davis.)

Although the occasional presence of definite adhesions in the joint in young infants suffering from birth palsy strongly suggests damage to the joint in these particular cases, I believe the traction theory best explains the condition present in the vast majority of the cases and that the subluxation of the shoulder joint develops gradually and as a direct result of the paralysis. I hold this view for the following reasons:

1. Tenderness and thickening over the plexus in the neck has been noted soon after birth in some cases.

2. The almost constant finding of definite injury, sometimes amounting to complete rupture, of one or more nerve bundles of the plexus during operation. Those most likely to be damaged by separation of head and shoulder, viz: fifth and sixth cervical, are the ones most found to be paralysed.

3. Experimental evidence that traction can produce tearing of these nerves, and that damage to the shoulder joint is extremely difficult to produce, fracture of the humerus or separation of its upper epiphysis occurring first. (Charles Taylor and Prout, Thomas and Sever, T. T. Thomas, and Stone.)

4. Taylor actually felt the plexus tear during delivery of a child, and the lesion was proved post mortem.

5. Subluxation of the joint is extremely rarely seen at birth, but its gradual development and fixation can be traced through cases of increasing age, the subluxation at first being reducible and becoming irreducible later.

6. Cases seen soon after birth with undoubted palsy and no joint injury have returned after some months with the palsy recovered but the joint sub-

luxated. In almost every case a history is given strongly suggesting an antecedent palsy.

7. Thomas and Sever in cadavers injected methylene blue into shoulder joint and then ruptured the anterior part of capsule. The blue never reached the nerves in the neck, where the lesions are usually found.

8. In seven cases of subluxation of shoulder in which Sharpe operated upon the nerves, a nerve lesion was found in all.

The *pathological* lesion varies from a slight tear of the peirineural sheath and haemorrhage into the nerve to complete rupture of the nerve trunk. Taylor found the sheath buckled inwards and preventing reunion of the nerve filaments. The site of the lesion varies in different cases though most observers agree that the fifth and sixth cervical nerves are more commonly affected than the others, and that the maximum damage is most often at the point of junction of these two nerves or immediately above it.

In some cases, usually those with extensive damage and paralysis, the lesions are close to the spinal cord, or the latter itself may be injured by the nerves having been literally pulled out by their roots. Boyer published a case of extensive damage to the cord and nerves while he and Burr believe that damage to the cord in these cases is not so uncommon as is usually supposed.

Types.

There are, of course, three clinical types, "the upper arm" (Erb. Duckam) "the lower arm" (Klumpke), and "the whole arm." The first is by far the commonest, the strain having been born by the highest nerves, the fifth and sixth cervical. The position of the limb is typical. The arm hangs vertically in full internal rotation, and with the forearm pronated and the palm looking outwards and the fingers usually clenched. The muscles chiefly affected spinati, deltoid, biceps and brachialis anticus, and supinator longus, i. e., the abductors and external rotators of the shoulder, flexors of elbow, and supinators of the forearm and sometimes the radial extensors of the wrist. The serratus magnus is not uncommonly affected to a considerable extent. The rigid dity sometimes met with is due to contraction of the unparalysed muscles and may result from tenderness in the neck over the site of the damaged nerves. I do not think we can quite exclude the possibility of damage to the shoulder joint in some cases, though subluxation is absent. At first passive movements of all the joints are usually free, but within a few weeks external rotation of the humerus, abduction of the shoulder, flexion of the elbow and supination of forearm become limited. As these contractures occur posterior subluxation of the shoulder gradually develops. To this I will return later. The vast majority of these cases recover almost completely though the supervention of a posterior subluxation is certain if adequate treatment has not been adopted. This deformity can, and should be, avoided. It is not uncommon to find wrist-drop as the sole remaining sign of the paralysis, all the other muscles having recovered, and associated with it is the usual subluxation of the shoulder.

The whole arm type is much more uncommon, while a paralysis limited to the lower nerves of the plexus only and due to traction on the fully abducted arm is even more rare. The prognosis in these is much less favorable than the upper arm type, particularly in lesions of the lower nerves. Sever says the lower nerves practically never recover. In these cases, in addition to the paralysis of all or some of the muscles of the arm the fibres going to the cervical sympathetic from these lower nerves may be paralysed leading to an active contracted pupil and narrowing of the palpebral fissure. Sever found partial or complete paralysis of the hand in 5% of 394 cases. As to the nerves commonly affected fifth and sixth cervical are undoubtedly those most often damaged. More rarely seventh cervical is implicated as well and still more rarely the whole plexus, while most rare of all is a lesion affecting the lower nerves only. It seems impossible to tell in most cases whether fifth cervical alone or fifth and sixth cervical together are damaged. Undoubtedly the bulk of the nerve supply

to the muscles paralysed in a typical case is derived from the fifth cervical. Harris and Low proved by operation in 4 cases that a lesion of fifth cervical alone can produce a typical palsy. They also proved that the fifth cervical sometimes supplies the radial extensors of the wrist.

As to the *treatment of the palsy* I always put the arm up with right-angle abduction and full external rotation of the shoulder, flexion of the elbow to a right-angle, full supination, and if necessary dorsi flexion of the wrist. I use this splint made of tin. The arm is taken down twice daily for massage and manipulations. The manipulations necessary are:

1. External rotation with and without abduction at the shoulder. This is the most important.
2. Full flexion and extension of the elbow.
3. Full supination of the forearm.
4. Dorsi flexion of wrist and fingers.
5. Adduction of the externally rotated arm while the scapula is depressed by a hand on the shoulder. This last is more necessary in the later stages, when recovery of the paralysis has occurred to a large extent, as tilting up of the scapula is one of the most frequent residual deformities. A tendency to winging of that bone is a not uncommon accompaniment.

How long should this treatment be carried on? Till all the muscles have recovered and all movements can be performed and all tendency to contracture has apparently disappeared. In a case seen in the first month of life the period necessary is about three months. The splint should then be removed for increasing periods each day till it is only worn at night and these changes should extend over a further three to six months. Later the splint may be discarded altogether but the manipulations should be carried out daily by the nurse, with a visit to the surgeon every three to six months, for the next two or three years. This may seem to be prolonging the treatment unduly, but my experience of cases regarded as cured before the war and seen recently, after a five years interval, with contracture developed, force one into emphasizing the importance of care in deciding that no further supervision is necessary.

At what age should exploration upon the plexus be under taken? If a case has been treated from the first, and after three months there is no sign of recovery, by physical examination and electrical tests under an anaesthetic, I think operation is advisable. Many surgeons consider three months too early. The age favoured by writers on this subject vary from two to twelve months. I am convinced that in most recovery is well advanced by the age of three months, and I think that rarely are the recognisable signs of recovery delayed beyond this period. Sharpe advises that cases of the whole arm type should be operated upon early (1 month). Although I admit that it is rare to find anything like complete recovery in a case of this general paralysis and that the presence of complete rupture of one or more nerves is not improbable, I think these cases do not lend themselves to radical operation in early infancy, for the operation is often difficult and prolonged, and several nerves will be found partially, though not completely, interrupted and lying in a mass of scar tissue, and when tests are made by direct electrical stimulation no exsection of damaged nerves will be considered advisable. The plexus is best explored through a transverse incision in one of the creases of the neck, converted into a T, with division of the clavicle, if difficulty is experienced in reaching healthy nerves below. If a nerve is found torn through, paring of the ends and secondary suture is the obvious treatment. The supra-scapular nerve must always receive careful attention and every effort made to suture it accurately. If a partial tear indicated by a neuromatous swelling on the nerves is present, the condition of the nerve fibres should be investigated by direct stimulation. Unless the condition of the nerves proves far better than clinical examination led you to expect, as may happen in a very fat baby, excision of the damaged parts and secondary suture is probably the right course to pursue. If the damage is so extensive that after excision the ends could not be brought together, the decision must depend on

the number of nerves damaged. If conduction in the fifth and sixth cervical is completely interrupted and seventh cervical is healthy I should prefer to leave sixth alone and graft the distal end of fifth cervical into a transverse cut in seventh cervical. If seventh cervical were also damaged I should leave the case alone. I do not approve of excision of the whole plexus and bridging the gaps in the nerves with catgut as done by Taylor.

If the lesion is near the cord and beyond the surgeon's reach I should perform a nerve anastomosis as was done in one of my cases, where fifth cervical was grafted into seventh cervical. Seventh cervical was chosen because apparently healthy, whereas sixth cervical was partially paralysed. The result when seen after 10 years was partial recovery of voluntary power in deltoid, both spinati, biceps and brachialis anticus, but not in supraspinatus. In the case of poliomyelitis in which a similar anastomosis was made, the result was similar though recovery of power was somewhat greater. In this case also the supinator remained paralysed. Freeing the damaged portions of the plexus is, of course, a necessary part of the operation, but I very much doubt if this procedure alone makes any difference to the prognosis. The same may be said of incising the nerve longitudinally. The loss of conductivity of fibres which are not actually torn is due to intraneural fibrosis and not to compression of the sheath, so incision cannot relieve the fibres in any way. The head must be approximated to the shoulder for two or three weeks after operation. Sharpe's method of approximating the hand of the affected arm to the opposite ear, by strapping, etc., seems good.

As to the findings of the five cases I operated upon they are shown in this diagram of the plexus. In case

1. Fifth and sixth cervical were torn through immediately above their junction. Secondary suture was performed at the age of 12 months. Three years later, the deltoid, biceps, brachialis anticus and intraspinatus were acting. At the present time, 13 years after the operation, and with practically no treatment in the meantime, he has limited external rotation and abduction of the shoulder, but all the muscles previously paralysed are acting except the extensors of the thumb.

2. Eight months old. The whole plexus was scarred and embedded in a mass of fibrous tissue.

Six years later, he appeared with a subluxated shoulder which was corrected by operation.

Now, after 13 years the arm is not very useful, owing to general weakness, particularly of the deltoid.

3. A doubtful case, but the right arm was absolutely powerless at birth but could move fingers when first seen at 18 months. Both arms were affected, and there was considerable rigidity and limitation of flexion at both elbows.

Both plexuses were explored, and nothing seen wrong with either, but on the left side fifth and sixth gave no response to stimulation, so they were divided at their junction and stitched into the seventh cervical. On the right, nothing was done, as each nerve gave some small amount of response. Three years later, the right arm had improved a little but the left was the same. It is possible that this was a congenital condition, and not due to injury at birth.

4. At 9 months, the typical muscles were paralysed and failed to respond to faradism. At operation nerves looked normal but stimulation of fifth and sixth cervical gave no response except in extensors of wrist. Fifth cervical was divided and the distal end anastomosed with seventh cervical (transverse slit). Eighteen months later there was no return of power in paralysed muscles but ten years later there was very considerable improvement, all the paralysed muscles acting and responding to faradism except the supinators. In flexing the elbow he still used the radial extensors, though biceps was acting.

The opposite arm was affected with poliomyelitis at the age of 7. (Photo.)

5. Operated upon in January, 1910, at 10 months, and fifth cervical was found scarred and adherent at the outer border of scalenus anticus. Phrenic was adherent to it and in fact apparently more damaged than fifth cervical. These nerves were freed and a twig from fifth cervical to phrenic preserved. Stimulation of the fifth cervical produced definite feeble contraction in deltoid (anterior part particularly) biceps, supinator longus and infra spinatus. The sheath of fifth cervical was incised, one definite constricting band being divided. Fifth cervical and phrenic were wrapped in Cargile membrane. This case was lost sight of three months later. The diaphragm was not paralysed on one side.

Kennedy has published some very satisfactory results after excision of the scar and secondary suture. In cases operated upon two or three months after birth obvious signs of return of power and response to faradism were noticed in about three months. Those operated upon later took longer to recover. Taylor also reports some promising results. In one case he excised the whole plexus and bridged the gaps with catgut, the whole being surrounded with Cargile membrane. Several muscles were acting a year later.

Now we have to consider the *subluxation*. It occurs in 40% of cases (Ashurst), and in 70% of my series of 60. It is due primarily to the want of support at the back of the joint, that is paresis of the posterior part of the deltoid, and infra-spinatus, or in other words, of the external rotators of the shoulder. It is associated with contracture of the internal rotators, the most important of which, probably because it is nearer the joint, and has the shortest fibres, is the subscapularis. It is possible that the insertion of the subscapularis acts as a fixed point, the head being tilted back as the shaft is flexed by the pectoral, etc. At first efforts at external rotation produce a reduction of the subluxation, but if untreated, the subluxation becomes irreducible. I have seen a reducible subluxation at six weeks, and an irreducible at four months. I have known it develop after six months.

The typical position of the arm is that of slight flexion, slight abduction, and internal rotation at the shoulder joint, with semi flexion of the elbow and pronation of the forearm. With the exception of the external rotators of the shoulder, the muscles previously paralysed have all recovered as a rule, though in some a wrist drop or paralysis of the supinator longus may remain. The scapula is small, is elevated and tilted upwards and slightly winged. On adducting the arm the scapula tilts up even more; in other words, adduction is limited. Abduction is also often limited, abduction plus flexion being much more readily performed, while abduction plus external rotation is quite impossible, owing to the contracture of the subscapularis and also to a less extent of the pectoralis major and teres major. Extension is also limited. Extension of the elbow is often limited though flexion is now full. Supination is sometimes limited, but by no means always. The child cannot turn the palm upwards because of the inability to externally rotate the humerus. The head of the radius in some is dislocated forwards or outwards, and according to Ashurst sometimes backwards. The X-rays up to a year or so show a humerus slightly smaller with the center for the head definiately smaller than that of the other arm, and lying at a lower level. The scapula is small and displaced as already described. Thomas and Sever have described the X-ray finding very fully. They mention a bending downwards and hooking of the acromion and a similar deformity of the coracoid, which I have also observed particularly during operations on the joint. The older the patient the more marked the bony changes.

Although the statement has been criticised by Ashurst and others, I still insist that the subluxation does not occur if the paralysis persists, and by paralysis I mean paralysis of the muscles around the shoulder joint usually paralysed in these cases. The displacement of the scapula must, I think, be due to paresis of the serratus magnus with secondary contracture of the levator anguli scapulae as suggested by Thomas and Sever. Anterior subluxation is said to occur by Thomas and Sever and Sherren, but I have not met with a case. With persistent paralysis the joint is, of course, more or less flail and the humerus might be drawn forwards by the unparalysed part of the pectoral.

TREATMENT.

If reducible and the child under a year, as is almost invariably the case, the subluxation can be cured in many cases by the use of the splint shown, and vigorous daily stretching of the weak muscles. The elbow and hand must be held well back in line with the shoulders. If this cannot be obtained by these simpler methods or treatment is being inefficiently carried out, it is better to divide the subscapularis right away and not waste time.

When the subluxation is irreducible I have not had any success with bloodless manipulations under an anaesthetic. Even Whitman and others who prefer this method admit the strong tendency to relapse after it. I prefer to divide the contracted muscles and other tissues through an anterior incision as described six years ago. The joint is reached by the usual incision between the pectoral and deltoid. The tendon of the biceps being diminutive in these cases, I prefer to expose it at the top of its groove so that its exact whereabouts is known. The joint is then opened just above the tendon of the subscapularis and as near as possible to its insertion, and this muscle together with the contracted capsule divided on an aneurysm needle passed down beneath them. At once the humerus can be rotated out and the head of the bone glides forward to its normal situation. If, as is usually the case, adduction is imperfect the coraco-humeral ligament is divided close to the thin biceps tendon, and even the supraspinatus may require division. I have not found it necessary to divide the pectoral completely nor the teres major, though they should be divided if they offer great resistance to combined abduction and external rotation of the humerus.

I used to follow Whitman and fix the limb in plaster for three months with the elbow to the side and well back, the humerus rotated out fully, the elbow at a right angle, and the forearm supinated.

Though this invariably led to cure of the subluxation considerable difficulty was experienced in obtaining both passive and active abduction afterwards, and I now think it is wiser to continue this fixation for only one month. The limb should then be fixed in abducted position in a removable plaster or metal splint, which can be taken off daily for active and passive movements, massage and electrical treatment. Flexion and internal rotation are the two movements requiring caution. With this proviso, the manipulation recommended for the early treatment of birth palsy should be carried out. A removable splint should be worn continuously for at least two months and then gradually discarded, but its use at night had better be continued for some months. I am informed that Whitman now changes the position of the arm from time to time after bloodless reduction of the subluxation. I think careful supervision is necessary so that any tendency to limitation of adduction or abduction can be immediately dealt with by fixation in the appropriate position. Some surgeons regard the pectoral as the chief element in the limitation of rotation and divide this, while osteotomy of the humerus high up (Stone), and below the middle (Hoffa) has been done to correct the internal rotation. The following additional procedures have been recommended by certain surgeons in special cases: division of coraco-brachialis and short head of biceps, cuneiform osteotomy of a hooked acromion (Sever), plication of spinati and teres minor (Ashurst), and plication of posterior capsule (T. T. Thomas). In anterior displacement simple division of the pectoral is recommended by Sever. Apart from the contractures and displacements already mentioned as resulting from the paralysis the following complications are among others mentioned by Sever.

1. Facial palsy by direct pressure of forceps.
2. Fracture of clavicle.
3. Fracture of humerus. One of my cases had this.
4. Dislocation of the head of the radius. This I have seen more than once.

I would add symptomatic wry neck, the head being deflected to relax the damaged nerves, and haematoma of the sternomastoid. I have seen the latter on

the same side as, and on the opposite side to, that on which the plexus is damaged.

In conclusion I venture to suggest the following points for particular discussion:

1. The non-operative treatment of the palsy. In what position and how should the limb be supported?

2. The age at which the operation on the plexus should be done.

3. What operative procedure should be carried out when simple secondary suture is impossible?

4. The cause of the subluxation and its treatment.

MR. BRISTOW: There has been one matter mentioned which I would like to say a word upon. It is as to the time at which one should operate. Mr. Fairbank said in three months. On general neurological principles, I think that this is inadvisable, because if you operate at the end of three months you operate from the point of view of diagnosis. It has been laid down by neurologists during the war that operation, in peripheral nerve work, may be considered as part of the diagnosis, and if an experienced surgeon operates under these conditions, he will do no harm. But in the lesions now under discussion, where, in any case, you are likely to find some strange lesion which you can do very little with, I think operation should be delayed to the very last. I think that these cases should be left for a year as a minimum, or 18 months, before attempting suture. Mr. Platt said it is impossible to arrive at a diagnosis as to true paralysis in a child, and he particularly tackled electrical reactions, stating that he had found, during the war, that the electrical reactions were of very little service to him in his peripheral nerve work. I think he is extraordinarily unfortunate, either in regard to the people who carried out the tests for him, and greatly to be blamed in that he did not learn to do them for himself. I do not know what is the general opinion of this meeting, but I do not doubt that one can definitely tell when there is paralysis. When you stimulate on the table you can certainly tell, but when you stimulate through the unbroken skin, coupled with the rest of the examination, the electrical finding is binding. I should be prepared to support that statement in regard to any particular case brought before me.

MR. R. C. ELMSLIE: Mr. Platt has appealed to us, as orthopaedic surgeons, to make up our minds as to what should be taught on this subject, and I think it is a very important point on which we ought to make our minds up. We have practically two opposing theories: first the pure nerve theory, and secondly, a theory which presumes some other injury not a nerve injury.

The nerve theory has always seemed to me to fall in very well with our clinical observations in tracing and following up these cases, considering not so much now the late cases which we see with posterior subluxation of the shoulder, but the early cases which we get to treat, those in early infancy.

I think the cases of birth palsy fall, clinically, into three groups: those which recover very quickly, often without treatment, those which recover more slowly, namely, in from three to twelve months, or even longer, and lastly, those which either recover very slowly or not at all or only partially. In my experience, the last group includes very few cases indeed, in fact I think those who do not recover at all are so few as hardly to exist. I have always felt that those three groups fall in very well with three groups of presumed pathological conditions: a condition in which there is injury to the nerve, not involving rupture of axis cylinders, a condition in which there is injury to the nerve involving rupture of axis cylinders, and a condition of injury to axis cylinder and separation of their ends. And I have thought it well to adopt these presumed pathological conditions in teaching on this subject. If we follow out the clinical

course of these cases, those which present contractures and which ultimately tend to get subluxation of the head of the humerus are those in which slow recovery takes place. I have myself watched contracture take place several times. I have seen a child who, at the end of three months from birth, had so much internal rotation contracture of the humerus that an assistant, in attempting external rotation, fractured the humerus. Following up these cases and watching the contracture has led me to believe that the late cases which we see with contracture and with posterior subluxation of the head of the humerus are nothing more than an exaggeration of that condition which is due to lack of early treatment or of continued treatment.

I would like to make a plea for the continuance of that teaching, at least for the present. By all means keep the open mind as to the occurrence of other lesions and injuries and as to the need of investigation concerning such lesions, but if we adopt the position that these are nerve lesions, that they tend to recover more or less rapidly, and that those which recover only slowly tend to end in contracture, we shall be adopting a teaching which will lead to sound treatment, and that is the essential in all our teaching.

Now one word about the operation for subluxation of the humerus. I have always put up the arm in the standard position, and I have been led to do that by considering always the difficulties of external rotation and of elevation of the arm, rather than that fixed position of abduction to which Mr. Fairbank calls attention. And the functional loss is due, I think, mostly to the lack of external rotation. For that reason I have used external rotation in the abducted position.

But what I wished to do was to bear my testimony to the very great value of the operation. I have always connected that operation with Mr. Fairbank's name, and for suitable cases it is an extraordinarily valuable operation. When one has been doing the operation, one has noticed that as the assistant is holding the arm and gently rotating it, at the time you divide the subscapularis it rolls right out immediately. When you do the operation it is at once evident that you have got hold of the real obstruction. I would like to ask Mr. Fairbank whether he can connect the forward subluxation of the head of the radius with the paralysed condition.

MR. GIRDLESTONE: Mr. Fairbank said he had advocated the transverse incision, but there is great doubt as to where the lesion may be found: it may be high up, or in the middle or low down. So one would advocate in these cases, as for brachial plexus lesions which we meet in military orthopaedics, complete exposure of the brachial plexus with division of the clavicle. By that means one gets the whole plexus under observation, and one can soon see definitely where the lesion is, if one is present there at all. Secondly, by this complete exposure one can secure very much more mobility of the ends after the removal of a large section. Where what Mr. Platt calls the terminations of the plexus are exposed and freed, it is much more possible to bridge this great gap and get end-to-end suture. If we adopt Mr. Bristow's suggestion and only operate on the late cases, then it is in those that there will have to be resection of the ends and approximation of the structures. The advantage of a longitudinal incision along the plexus seems to be great from that point of view, as well as that of the diagnosis of the lesion.

MR. AITKEN: We are deeply indebted to both Mr. Fairbank and Mr. Platt for their papers. I confess I am not well enough up in the literature of the subject to follow Mr. Fairbank's paper until I see it in print and have an opportunity of studying it at leisure. But I express myself as entirely in agreement with the principles which have been laid down by Mr. Elmslie in his remarks in regard to treatment, except that I have never yet performed the open operation for subluxation or extreme internal rotation, which is what I have been inclined to regard it as. But there is one point which, I think, might have been elucidated more clearly, namely, the question of fifth and sixth root haemorrhages. I think we are all agreed that disturbance within the nerve sheath is very easily

produced in nerve trunks. I have paralysed the posterior interosseous nerve by a retractor, and I do not think there is any evidence in the *post mortem* experiments that the force employed in a difficult labour might not produce capillary haemorrhages within the sheath, haemorrhages which would cause considerable pressure. Of this I have seen two examples in adults. One is quite clear in my mind, and the other followed at an interval of a couple of months. Both cases were in working men, who had fallen off a scaffold on the shoulder, and both had a typical fifth and sixth nerve palsy. In one of the cases we considered whether we could cut down on the nerve root when Sir D'Arcy Power said, with that rare diagnostic intuition, "That is a capillary haemorrhage within the trunk: leave it alone, only treating it on general principles, and there will be recovery." Both did recover. And I had a case the other day which reminded me of them. It was the case of a soldier who had been buried at the Front, and he told me he had had transient paralysis of his arm, which had recovered, and in which the injury was evidently something of the same kind.

In regard to the general discussion about these high haemorrhages, I do not know that a sufficiently clear line has been drawn between what are brachial plexus haemorrhages and what has been my idea of birth palsy, lesions within the cord, which may be ante-natal haemorrhages, poliomyelitis, or even in some of the cases, cortical haemorrhages corresponding to birth palsies. In that connection I have a case in a relative of my own who came home from the East at 8 years of age with what I took to be a typical untreated birth palsy. The X-ray picture showed rotation and bending of the radius, with subluxation of the head of the radius. The first thing I tackled was the luxation of the radius, which, by persistent external rotation and flexion, I could drive back into position. On further examination I discovered the merest trace of spasticity of the foot, and then I put the case down not as a mere birth palsy, but a cerebral hemiplegia.

There is another point which I think it might be some advantage to members to refer to, that is the position of the arm in correcting internal rotation or luxation of the shoulder. McMurray, in Liverpool, has devised a very convenient splint, which keeps the arm close to the side. It is divided into two pieces: a shoulder part, and a part for the arm and hand. The upper portion has a chest piece, which prevents internal rotation: one portion slides into the other, somewhat like a trombone. You cannot put it all on in one piece, you cannot get it applied to both ends simultaneously. In one boy born in India whom I didn't see till he came home to school, I was able to place the arm in successive positions in plaster and in that way largely to overcome the internal rotation. During the war I have been treating him at intervals, and I think that possibly had I divided the subscapularis I might have procured the result more quickly. But he is now playing cricket and all other games at an English public school. I was fortunate, in the boy's preparatory and in the public school, to get a gymnastic instructor to deal with the arm by passive rotation and external rotation exercises every day. And I think that in our hospitals where there is a good gymnasium, we get over the difficulty more easily than in Great Ormond Street Children's Hospital, as the exercises can be given for a long period. And there I agree with Mr. Elmslie, that they ought all to be first treated by position. I do not see what good you are likely to do by operating on the brachial plexus, but that may be my obstinacy: my impression has been that the few cases which did not recover were not birth palsy. There, again, it is a question of definition, namely, what you will include in birth palsies: at present I think the margins are not well defined between lesions of the brachial plexus, which I have been in the habit of regarding as "birth palsies" and higher lesions in the cord or brain, which are less amenable to treatment.

MR. LAMING EVANS: May I ask Mr. Fairbank a question on one point which he did not make clear to me? I refer to the age-limit at which he has successfully carried out his open operation with reduction and retention. Also, has he found difficulty in retention from secondary deformities, namely, obliquity of the head, or obliquity of the glenoid?

MR. FAIRBANK (in reply): I have to thank all the speakers for having given us their views. One or two very kindly criticised the paper.

With regard to the case of subluxation with persistent paralysis quoted by Mr. Platt, it is very difficult to answer: there have been two or three such cases reported. I think Ashurst reported one in which, although he said the paralysis did not recover, I do not think he proved it, according to his own account.

Mr. Platt, I understood, said you could not judge by the results of electrical tests of muscles whether cases had recovered or not. Therefore I think his case also is open to uncertainty: I should have said the subscapularis had recovered in that case. I believe there was only a small tendency to posterior displacement ("Yes"), and it was not a real subluxation: therefore I think one may say the subscapularis had recovered to some extent, but that the other muscles, not having been relaxed as the subscapularis was by the help of the pectoral, had not recovered sufficiently to give the reaction through the skin and subcutaneous fat. I am open to conviction, and admitting this to be an exception, I think my contention does hold good for the vast majority of cases, and that even if this case were admitted, it would be merely the exception which proves the rule.

Mr. Platt seemed to favour the idea of injury of the peripheral nerves, that the terminal branches of the plexus have been injured in connection with the injury of the shoulder joint. But it has always been hard for me to see how that could happen. To injure the nerves running on the front of a joint, presumably you must damage the joint, and the accident to the joint would damage the anterior portion of the capsule. I do not see how displacement of the head of the humerus, or the force exerted on the anterior part of the capsule, can injure those nerves except by hyper-extension of the joint, extending the nerves over the head of the humerus. If this is correct, why should the head of the humerus go towards the back? If you were to tear the anterior part of the capsule, you would expect the head to be displaced forwards. Some have stated that there is injury to the nerves after the humerus is displaced. If it is displaced to the back, it cannot hurt any nerve, except the circumflex. The suprascapular nerve is one particular nerve affected, and this is beyond the reach of damage by the head of the humerus. Hence I cannot understand the theory of direct injury.

Mr. Bristow said three months was too soon to operate, but I think we have to remember we are not dealing with adults. My view is based largely on the experience that in the vast majority of cases there are signs of recovery in three months. The fact that I have only opened five out of sixty shows that I have not 'rushed" at the operation. The child will increase in size: it is not like the case of the adult in which the nerve ends will remain where they are. If the fifth and sixth are torn, if you wait long the nerves will be further apart, and the condition will be harder to deal with than at three months. Therefore I am inclined to retain my idea as to the three months. That has also been advocated by other people, namely, the advantage of operating early before the nerves have separated to a large extent.

In answer to Mr. Elmslie, I agree we should have a more or less agreed line, though we are not likely to agree on everything. I do not agree with him that those cases which recover slowly are those which get subluxation. The child I showed at six weeks had some subluxation.

With regard to the remark concerning the head of the radius, I was at first inclined to regard them as ante-natal conditions. But there is a limitation of extension which is common, and I am sure this develops as a result, or as an accompaniment of the subluxation. Whether any tension on the biceps could help towards that anterior displacement of the head of the radius, I do not know. I have not any satisfactory explanation to offer: all I can think of is tension on the biceps. Someone described a tendency to posterior subluxation on account of long-continued slight flexion and marked pronation. I have not observed that displacement.

With regard to the advocacy of an oblique rather than a transverse incision, I like the transverse one, because I think it gives good exposure in the ordinary

case. If there is any difficulty I make it into a T-shaped incision, and then drill and divide the clavicle.

Mr. Laming Evans asked as to operation on the joint. Those two cases I showed—the boy and girl, aged 9 and 10—were the oldest I have operated upon, and I think the photographs show they were reduced, the boy unquestionably, though the girl I was not quite satisfied with. She was 9 years of age.

THE PRESIDENT: We are very much obliged to Mr. Trethowan for showing these interesting cases. They open up promise for the future, and I hope he will do still more operations of the kind and have better results. We have not time to discuss the matter now.

MR. HARRY PLATT (in reply): I have nothing further of any consequence to add to my previous remarks. What I have attempted was to trace the evolution of the views which are before us today concerning the etiology of this condition —views put forward by men of repute and exceedingly conflicting ones.

The early treatment of cases of birth paralysis fortunately is the same no matter what the exact lesion may be, i. e., fixation of the limb in the standard posture. Mr. Fairbank has found the result of the operative treatment of the subluxation good in that the head of the humerus remains in place. This has been my experience even in older children. The great difficulty however is getting full mobility of the limb apart from the scapula.

Announcements

Dr. Starr, President of the American Orthopedic Association, writes that the clinical day for the June meeting of the American Orthopedic Association is shaping up in good form. It is intended to have a programme which will be both profitable and enjoyable. A large attendance is expected on the first day. The University is co-operating in their desire to make our meeting successful. Arrangements are practically completed to hold the meetings in the Medical department of the University; and as the University is some distance from the hotel, luncheon will be served in the new Hart House dining-hall for the convenience of members.

ORTHOPAEDIC SECTION OF THE CANADIAN MEDICAL ASSOCIATION

June 22nd to 25th, Vancouver, B. C.

PROGRAMME

Dr. V. P. Gibney, "Scope and Development of Orthopaedic Surgery." New York.

Dr. F. H. Albee, "Reconstructive Surgery" (illustrated by moving pictures and lantern slides). New York.

Dr. H. Winnett Orr, "What Can We Do for the 'Hopeless Cripple?'" (Illustrated with lantern slides.) Lincoln, Nebr.

Dr. E. G. Abbott, "Compression Fractures of the Spine." Portland, Maine.

Dr. H. P. H. Galloway, "Treatment of Fracture of Neck of Femur." Winnipeg, Man.

Dr. A. R. MacAusland, "Treatment of Fractures." Boston, Mass.

Dr. James Patterson, "Painful Feet." Vancouver, B. C.

Dr. A. Gibson, "Treatment of Recurrent Dislocation of Shoulder." Winnipeg, Man.

Other papers of interest have been promised.

Personal

The fifth meeting of the International Society of Surgery will be held July 19th to 23d, in Paris, under the presidency of Dr. W. W. Keen, of Philadelphia. Treatment of fractures of the thigh is one of the six subjects assigned for discussion.

At the annual business meeting of the American Posture League, March 13, the following officers were elected: president, Jessie H. Bancroft; vice president, Dr. Frederick R. Green, Chicago; secretary, Dr. Henry Ling Taylor, New York City, and treasurer, Dr. George J. Fisher, New York City. The annual public meeting of the league was held this week concurrently with that of the American Physical Education Association in New York City.

A small experiment station for the study of the problems of invalid occupation has been established at Marblehead, Mass.

The Rizzoli Orthopedic Institute, Bologna, Italy, announces that competition for the prize Umberto I has been opened. The prize of 3,500 lire (normally $700) will be assigned by the provincial council of Bologna for "the best orthopedic work or invention." Both Italian and foreign physicians may take part in this competition. The regulations of the competition will be sent to any one who applies to Dr. G. Zanardi, president of the Rizzoli Institute, Bologna. The competition will close December 31.

Dr. Bernard Barton of Buffalo died on March 28 following a suppurature appendicitis. Dr. Barton improved after operative drainage. The appendix was found to be ruptured. After about a week, however, heart and lung complications arose and proved fatal. Dr. Barton was one of the older members of the American Orthopedic Association. He was usually present at the meetings and always an enthusiastic supporter of its interests and affairs. Moreover he was held in the highest personal esteem by those who were privileged to know him.

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Current Orthopaedic Literature

TREATMENT OF TUBERCULOUS OSTEO-ARTHRITIS BY BONE GRAFTS. By Carlos Robertson Lavalle, Buenos Aires, Argentine. *Surg., Gynec., and Obstetrics*, Vol. XXX, March, 1920, No. 3.

We have passed through the stages of amputation of the diseased limb above the lesion; total resection of the diseased joint—extirpated as one would extirpate a tumor—and a typical resection, the diseased portion being carefully sought out in the articulation and the adjoining bones in order to extirpate them, interfering as little as possible with the cartilaginous line of growth and leaving the bony surfaces in shape thereby facilitating the formation of a new joint.

Deep cauterization as an alternative for destroying the tuberculous foci, finally provoking cicatrical sclerosis of the lesion; the filling up of curetted cavities; and the use of modifying subcutaneous injections which suffocate and silence the focus sometimes by surrounding it with fluid, making it more easy to draw off the products of infection by repeated puncture—these are all processes which introduce a new period in the history of the treatment of the disease.

The treatment of tuberculin—a biological process practically dominating all former methods—heliotherapy, and rest are today procedures which have proved very successful according to our statistics. These methods have placed an efficacious means of treatment in the hands of any who persistently follow a consistent program of application.

The present method of treatment is non-radical or non-surgical.

The epiphysis is composed of spongy tissue, which is limited on one side by the cartilaginous line of growth and on the other by the articular surface. This surface is not entered by large vessels at any point but receives its blood vessels only from the periosteum covering the lateral and peripheral surfaces of the bone, which is re-enforced by the capsule of the joint, ligaments and tendinous insertions near which there are also blood vessels. When the capsule is overdistended by articular effusion, its vessels are also distended and thus because of their lessened lumen the blood supply to the epiphysis is diminished.

The osseous system is constantly active in a struggle between the osteoblasts, which form bone, and the other elements peculiar to the marrow, the marrow cells and the myeloplaxes, the latter of which give way to the osteoclasts, destroyers of bone; and it is owing to the greater production of osteoblasts that the bone develops in the child. Later, in the adult, the osteoblasts and osteoclasts are produced in equal amounts. In old age, the bone becomes thinner, due to the excess production of the osteoclast. Success in the struggle sways from one side to the other in the different pathological states of the bone marrow.

The embolism which localizes in a bone and which generally comes from a primary focus, especially from a lymphatic gland, provokes a tuberculous marrow infection, that is, the bone marrow is sown with tubercular follicles which undergo mucous degeneration, its elements become embryonic in type, and its

peripheral capillaries are for the time being dilated while the central capillaries near the focus, in which abound tuberculous follicles undergoing degeneration, are obliterated. These lesions produce a rarefying avascular osteitis in the trabeculae of the bone, which is also toxic and partly due to the osteoclast.

The result in the competition of both systems is that the more rarefying the osteitis becomes the less is the intratrabecular marrow helped in its struggle to smother the invader; it is overcome and the tuberculous process gains ground and the alveoli, every day becoming larger, give better protection to the roots of the granulations which, once the cartilage is destroyed or raised, penetrate into the synovial cavity sowing it with tubercles.

These predominant lesions of rarefying osteitis are accompanied by a very accentuated venous stasis and by a reduction of the blood supply through the epiphyseal arterioles, due to oedema of the periosteum to a distention of the soft periarticular tissues and to lession of mal-position following on reflex muscular contraction—causes which act more especially on the venous walls which are more depressable than those of the arterioles which are already contracted by the action of the tuberculous toxins.

To sum up, we have venous stasis, little flow of arterial blood, extravasated liquids, sluggishness in metabolism, lesions of mal-position through reflex muscular contraction, and rarefying osteitis.

Rest, and here the best results are obtained from continued extension, acts as a depleting agent by uniformly compressing, through the medium of the soft tissues, the articulation and the epiphyseal surfaces, facilitating the reabsorption of the extravasated liquids in the oedematous tissues which have undergone embryonic transformation.

It facilitates, by compression, the circulation of the blood, it lessens the venous stasis for this reason and because it eliminates the congestion that mal-position has provoked through reflex muscular contraction. This contraction is overcome by continued extension.

Heliotherapy, apart from its action on the phagocytosis and its general tonic effect, acts as an alterative, since it is well known that the more the skin becomes pigmented the more efficacious is the treatment. This alterative provokes dilation of the vessels, greater rapidity in the blood circulation and therefore reabsorption of exuded liquids which overwhelm the diseased tissues which prevent an efficacious interchange of nutrition and the effective phagocytosis in the struggle against the tuberculous process.

The cautery, by which Charcot has already cured several cases of spinal cord compression due to vertebral osteo arthritis, has proved a good method of replacing effective alterative processes but this is not so far reaching as heliotherapy and is more transitory and discontinuous; there is always a danger of secondary infection.

By therapeutic action we can facilitate an alterative procedure in the periphery of the diseased articulation, increase the arterial circulation and lessen the venous stasis, eliminate the malformations, increase the nutritive interchange and reabsorb the exuded liquids.

The subcortical bone fulfills these two requirements: (1) that of vascularized spongy tissue and (2) that in process of forming new bone; whereas the cortical bone tissue is already more condensed. In the marrow there are two

principal elements, one of vascularized and the other of fatty material, which later, on being traumatized during the severe operation of being compressed with the graft, give rise to large haematomata impeding or retarding the capillary penetration of the graft producing necrosis of the graft, whereby it is reabsorbed.

Convinced of the effectiveness of the use of bone graft when properly applied, we will see how it can be utilized to accomplish its purpose.

1. Because of its trophic action, the graft has the virtue of producing in the surrounding area condensing osteitis, improving the power of latent ossification, which is especially abundant in bones in which there is some inflammatory process such as tuberculous epiphysitis, which weakens when it is not assisted and ends in total rarefying osteitis. Hence a sheet of bony tissue was placed within the epiphysis. This would produce a condensing osteitis and the lessening of the diameters of the osseus alveoli would suffocate the roots of the granulations which had previously taken ample hold but which under the new conditions would atrophy.

2. The graft, placed so as to extend from the diaphysis without touching the articular cavity, would cross the cartilaginos line of growth and as Haver's canals of the graft are rapidly and abundantly penetrated by capillaries, they would serve to overcome the venous congestion and carry arterial blood to the epiphysis. We observe also that the perforation of the cartilaginous line of growth by the bone graft depletes the venous congestion. This is easily established for the epiphysis is practically isolated from the circulatory current, as its articular and diaphyseal faces, covered with cartilage, do not permit the passage of vessels and veins, which go out through the lateral parts of the epiphysis and then are compressed by the oedema of the periosteum. To produce and maintain an active, permanent and aseptic deviation of the blood current, —such as can be secured by means of heliotherapy and which is better than that produced by means of the cautery—and thus combat the epiphyseal venous congestion, two lateral grafts are placed in the cellular subcutaneous tissue surrounding the articulation so that there are points of implantation in bony sites at both extremities of the grafts. These grafts are at once copiously penetrated by capillaries thus depleting the central congestion by the aspiration which this rapid peripheral circulation produces.

The application of extension, bandages, and weights is continued for three months, which have been put on 15 days before intervention so that it will not be necessary to perform the operation in the presence of an active tuberculous lesion. After three months the patient can get up, wearing light plaster bandages which keep the joint immobile.

During all this time, the lateral grafts have been growing and from the size of a toothpick they have become in six months of the breadth and thickness of a rib. The course of the disease is studied by roentgenograms which show clearing up of the rarefying osteitis; and by palpation which shows that the granulations and the pain have also disappeared. At this stage of the subcutaneous lateral supports are removed, and within 10 to 12 days after this slight operation, the patient is turned over to a masseur for treatment to bring back mobility to the point. The joint is not very stiff as play on the normal axes of the articulation has been possible, as muscular contraction no longer exists

and the lateral grafts have molded their extremities into angular shape acting as a pivot.

X ray was given up in later cases and moderate heliotherapy is being used, more as a matter of hygiene and as a general tonic than for its local action.

From the first days following intervention, an improvement can be noted, improvement in the general condition, increase in the color of the mucous membrane, disappearance of the yellowish tint in the skin, and a better appetite. These are all indications of a lessor quantity of tuberculous toxins produced and absorbed in the focus.—*Leo C. Donnelly, Detroit.*

TUBERCULOUS HIP WITH CONGENITAL DISLOCATION. U. Caesarono. *La Chirurg. d. organi di movimento*, December, 1919.

Records two examples of tuberculosis developing in congenitally dislocated hips after reduction. In the first case, a child of 2 1-2 years with a double congenital dislocation, reduction was obtained at the first sitting but with some difficulty, more especially with the right hip. Six months afterwards it was noticed that the right hip had a tendency to redislocation, and two and a half months later the child had a painful swollen right hip and an abscess pointing on the lateral aspect of the joint. A radiogram showed partial destruction of the head of the femur, the stump of the neck being in contact with the acetabulum; on the left side the head of the femur was in position in the acetabulum; and showed no abnormality. The abscess was aspirated; tubercle bacilli were found in the thick pus. The right hip-joint was now immobilized securely in a long plaster-of-Paris spica. During the ensuing twelve months the disease became more quiescent. At the end of this period the right hip still showed a sinus in the region of the old abscess; the joint was mobile and the trochanter was elevated; in the radiogram complete disappearance of the head of the femur was evident. The left hip was mobile in all directions and the reduction of the dislocation had been maintained. The second case was also a child of 2½ years, but in this instance the reduction of a bilateral dislocation was effected with ease. After seven months walking was allowed, satisfactory evidence of stability being present. Soon afterwards a light celluloid apparatus was fitted to correct a tendency to anterior transposition in both hips. The patient was not seen again until nine years later. There was a history of a fall on the right hip some months previously and this joint was now painful and swollen. All movements were limited, and in a radiogram the right hip showed complete absence of the head of the femur, the neck being fused to the remains of the acetabulum; the pelvis was extremely atrophic, in striking contrast to the left side. The left hip-joint showed that reduction had been maintained, but was not concentric. An abcess appeared some months afterwards over the right hip; this burst spontaneously and left a sinus, which was unhealed at the time of reporting the case. The author states that out of 2,000 congenital dislocations of the hip-joint treated in the Instituto Ortopedico Rizzoli in Bologna these two cases are the only examples of tuberculous arthritis developing after reduction. He holds that

the connexion between trauma and the local development of tuberculosis is firmly established and that the cases he reports offer convincing evidence of this casual relationship. In the first case the hip in which reduction was difficult, and therefore in which there was a considerable trauma, became the seat of the disease. In the second case long after reduction a definite external injury was the exciting cause.—*From the British Medical Journal.*

THE TREATMENT OF PSEUDOARTHROSIS WITH INJECTIONS OF TINCTURE OF IODINE AND WITH A FENESTRATED PLASTER SPLINT. A. F. Brunzel. *Deutsch. Ztschr. f. Chirurgie*, Bd. 149, H. 5-6. S. 394.

Two methods of treatment of ununited fractures are described in this article. The first consists in the injection of an alcoholic solution of tincture of iodine between the bone ends. He uses a solution consisting of equal parts of a 5% tincture of iodine and 96% alcohol; he injects as much as 20 cc. This injection is given with a small needle so that the point touches the ununited bone ends, penetrates the intervening fibrous tissue and, if possible, the periosteum of the pesudoarthrotic terminals. In each of these three places a few cubic centimeters are injected. The procedure is painful and should therefore be preceded by a local anaesthetic and followed by morphine, about half an hour after the injections are given.

The iodine, the author claims, causes an inflammation between the ends and a fibrous exudation favorable for bone union.

The other method consists in cutting a window in a well fitting plaster splint just over the place of non-union. When the patient walks, the fenestrum fills with edematous tissue which acts like a strong passive hyperemia on the fractured area. The cast must be applied over very little padding and be correctly fitting.

Both methods, especially the latter, have given the author excellent results in many troublesome and long standing cases of pseudoarthrosis.—*A. Gottlieb, San Francisco, Calif.*

INDICATIONS FOR TENDON TRANSPLANTATION AND ITS APPLICATION IN PARALYSIS OF PERIPHERAL NERVES. George Hohman. *Muench. Med. Wochenschrift*, November 26, 1918, No. 48.

The author gives the following indications for the transplantation of tendons in paralysis which result from injury or severance to peripheral nerves:

1. Non-appearance of function two years after nerve suture with perfect healing of the wound.
2. Suppuration of the wound after the nerve is sutured, because it is presumed that the nerve has not perfectly united.
3. Impossibility to suture the nerve in view of the wide gap between the severed nerve ends.
4. Lapse of time for nerve suture. The author takes as a time limit about one and a half years.

5. Nerve injuries near a place where the nerve divides and branches out.

He describes the various methods which he uses for the transplantation of tendons in different regions of the upper and lower extremities and advocates early motion of the operated part.—*A. Gottlieb, San Francisco, Calif.*

RESTORATION OF LOSS OF BONE, INCLUDING AN ANALYSIS OF THE FIRST HUNDRED CASES OF FRACTURE TREATED BY BONE GRAFT AT U. S. ARMY GENERAL HOSPITAL No. 3 COLONIA, N. J. Fred H. Albee, M. D., Sc. D., Assisted by Elmer P. Weigel, M. D., New York. *Journal A. M. A.*, Vol. 74, No. 9, February 28, 1920.

The surgical repair of bone, and more particularly the use of the bone graft in cases of pseudarthrosis with or without bone loss, is based not only on the ultimate establishment of adequate fixation of the bone fragments, but also on the attainment of a proper bed for the nourishment of the graft. This entails the exact coaptation of parts of the graft to respective parts of the host bone; in other words, the adequate and extensive contact of all four corresponding bone layers, namely periosteum, cortex, endosteum and marrow.

The author has been greatly impressed with the striking influence exerted by mechanical stress on the growth and metabolism of bone. In cases of loss of substance of long duration, in the radius, humerus or any long bone, the bone cortex has often become reduced to one-fifth its normal thickness, almost to egg shell consistency, largely owing to removal of the stimulus of mechanical stress. Such a condition is in direct sequence to the general physiological law of bone growth; it is a magnification of Wolff's law. If bone, whose nourishment and blood supply have not been greatly impaired, should suffer so materially as a result of loss of the stimulus of mechanical stress, how much greater must be the effect of the same inhibitory influences on any free bone graft whose blood supply and nourishment are not yet established.

In work on bone tissues, which easily dry on exposure to the air, operative speed is necessary; in the repair of bone that from lack of the stimulus afforded by mechanical stress has become almost eggshell-like in consistency, great delicacy of technic and operative speed are fundamental requirements in the difficult work of inserting the necessary inlay. It would be impossible to execute such accurate inlay technic by the former laborious methods with mallet and chisel, or osteotome. In work of this nature, in which the operating field is frequently limited, where fragility of bone may be a constant menace to success and in which an accurate cabinet-maker fit of parts is indispensable, an electrically driven rotary twin-saw seems absolutely essential. In contradistinction to a recent assertion, it is emphatically stated that the motor-saw, when properly used, does not heat or glaze the bone. During various operations in the past few months, the author has made repeated attempts to determine whether heat was generated by the motor saw when used properly, and if so, to what degree. In every instance it has been found that the most delicately adjusted thermometers have failed to register an increase in temperature, even to a fraction of a degree, when placed directly on the motor-saw or on the bone immediately following the withdrawal of the instrument.

For the inlay graft, accurately cut and fitted by motor saw technic, the fixation afforded by kangaroo sutures is adequate and preferable to that of all metal agents. The practice of inserting metal plates is absolutely contraindicated in this work.

Of the 100 cases, 79 involved bones in which injury resulted from high explosive shell, machine gun bullet, or shrapnel; 17 were simple fractures of the long bones; the remaining 4 cases were compression fractures of the spinal vertebrae. All the simple fractures and the spine cases have been successfully treated, in that they have healed, in each instance, without infection, and have shown bone growth by roentgenographic examination within a reasonable period after transplantation of the graft. In every case of fracture of the long bones, function has been restored, while in the spine cases there has been an inhibition of symptoms.

Of the 79 cases of fracture by projectiles, treated by bone graft, 65 or 82% were for loss of substance varying in amount from one-half inch to six inches, and averaging about two inches; 10 cases were for non-union without loss of bone; the remaining 4 cases were of mal-union.

Owing to the exposure of the upper part of the body in trench warfare, shoulder injuries, and particularly those involving the upper part of the humerus, have been frequent in the recent war. Through the rather extensive practice of certain surgeons at the front, more especially of the French, of removing large portions of bone at or near the shoulder-joint in such injuries as these, there has resulted a notable group of cases in which shoulder function is very nearly negligible, if not entirely destroyed, on account of the loss of bony framework over which the shoulder muscles might play.

The high frequency of shoulder and forearm injuries compared with those of the lower extremity has occurred in a ratio of 4 to 1 in 79 cases. Of the total number of injuries in the upper extremity, the humerus has been involved in 14 instances, or more than 25%. Cases of loss of substance in the humerus with loss of shoulder function have been classified in two groups, with respect to treatment:

Group 1. Restoration of Shoulder Motion and Function: This class consists of cases in which the humerus has been destroyed, but the musculature has been sufficiently preserved to enable the surgeon to hope for a return of shoulder-joint motion and function, provided the bone be replaced. The author has restored motion and function in such cases by transplanting into the humeral fragment the head and upper end of the fibula to replace the upper portion of the humerus that has been destroyed. He has resorted to this operation many times in his civil practice, as well as in military work, and has invariably found that the patient can functionate satisfactorily without the upper end of the fibula. Whenever possible, the principal muscles of the shoulder, such as the pectoralis major, the supraspinatus and the subscapularis, are firmly affixed subperiosteally to the transplanted head and neck of the fibula.

Group 2. Shoulder Function Restored by Compensatory Scapulo-thoracic Motion. This group includes cases in which, in addition to loss of bone, the musculature of the shoulder has been destroyed or severely injured to such a degree that one cannot hope to secure a return of shoulder-joint motion. The loss of bone is restored by ankylosing the humerus to the scapula by a truss-work

of tibial grafts, usually two in number. During the union of the grafts the arm is immobilized in an elevated anterior posture, and is held in such relation to the scapula that the powerful scapulothoracic muscles which control this bone may later move it. Thus by causing the scapulothoracic motion to compensate for loss of shoulder motion of the arm, the lost motion of the arm and shoulder is restored to a surprising degree.

Restoration of the shaft of the humerus, femur, tibia or any long, large bone has been accomplished by means of a graft inlaid by the author's usual inlay technic. On bones of the forearm, or on any bone of small diameter, or in cases in which a bone of large diameter has become conical-ended, the mode of repair resorted to is designated for purpose of description, as the 'fishpole." technic, since a similar method is employed by the artisan in mending a fishpole.

The influence of stress on the hypertrophy and metabolism of bone has been more strikingly illustrated in bone graft restoration of the shafts of long bones than in any similar class of work. However small the diameter of the graft, provided it be protected from fracture by external support and at the same time be allowed to withstand stress, it will eventually restore the lost bone in almost anatomic particular, namely, in diameter, strength and external contour, as well as in respect to the internal architecture.

By making the most of all known mechanical joints and by the insertion of kangaroo tendon in such a way as to afford the best internal fixation, in conjunction with the most perfect external fixation by plaster-of-Paris dressings, the extremity being placed in various "positions of neutral muscle-pull" immobilization of the involved fragment has been found possible. Too great emphasis cannot be laid on the importance of putting absorbable ligatures in the skin, so that carefully applied Plaster-of-Paris dressings need not be disturbed for a period of at least eight weeks after implantation of the graft. Plain catgut No. 0 or No. 1 with suture-holes puddled with tincture of iodine, serves admirably for this purpose. Chromic catgut No. 0 or No. 1 is also suitable. The buried sutures in the soft parts should always be small in diameter and as limited in number as possible. The only adequate postoperative dressing in these cases is the plaster-of-Paris splint, applied with the utmost care and molded to the bony contours of the extremity. It should always include at least one joint above and one joint below the bone involved, with due attention given to position, which is of the greatest importance.

Synthetic Grafting of Tissues in Construction of New Fingers.

In two cases of loss of four fingers with the adjoining metacarpal bones as a result of high explosive shell and shrapnel wounds, the hands were completely helpless, so far as grasping and holding were concerned. Function has been restored to a great extent by the synthetic construction of new digits. By providing an opposing surface to the thumb, the usefulness of the member has in each instance been restored.

In plastic work of this nature, which involves the transplantation of more than one kind of tissue, a two-step or multiple-step procedure is the only method whereby a successful sequence may be expected. It is essential in handling soft parts and bone that the skin and subcutaneous tissues be firmly united with the host tissue and that circulation be well established before implantation

of bone. Ease of technic and the possibility of obtaining ample soft tissues and bone have also led the author to recommend strongly this type of operative procedure.

RELIEF OF COMPRESSION FRACTURE OF THE VERTEBRAE.—The use of the bone graft as a means for relief of compression fractures of the vertebral bodies has afforded satisfactory results. On account of meager bone growth and inadequate bone repair around crushed vertebral bodies, and because of constant interference with bony union by the respiratory and voluntary motion, nature, unassisted, does not bring about the proper repair in these cases, even though efficient external means of immobilization be employed for months, sometimes even for years. To supply the deficiency resulting from lack of bone repair, the bone graft offers a sure means of relief and its indications in such cases are as definite as in any pathological or traumatic condition encountered.—*Leo C. Donnelly, Detroit.*

A CASE OF BI-LATERAL RECURRENT PARALYSIS OF THE MUSCULO-SPIRAL NERVE. V. Putti. *La Chirurgia degli organi di movimento*, February, 1920.

The author reports extensively the history of a girl of 13 years of age who had been a patient at the Istituto Rizzoli for the last four years. She reported first with complete paralysis of the right musculo-spiral nerve, the triceps alone responding normally to electric examination. The arm showed a small reddish speck on the outside resembling a suffusion and an open operation was done which consisted in cutting down upon the musculo-spiral nerve between the middle and lower third of the humerus. It was found that a bluish spot existed underneath the sheath of the nerve together with some induration of the nerve structure. The tract of the injured nerve was encased in the sheath and artery prepared according to Faramitti.

The most amazing thing was the persistent recurrence of the paralysis after apparently completely cured, and the appearance of the same paralysis on the left side. From October, 1913, to the present time, which is within 6 years, the musculo-spiral nerve of the right side was paralyzed four times, that of the left side three times. When last seen the musculo-spiral nerve of both sides was paralyzed. There were also some important nutritive changes noticed, especially in the latter part of observation. The fingers of both hands were the seat of numerous congelations which were partly ulcerated. There was also on the right side a torpid, secreting spot which had appeared without apparent cause. Galvanic and faradic excitability were lost in muscles as well as nerves.—*A. Steindler, Iowa City, Ia.*

THE RECONSTRUCTION OF THE CRUCIAL LIGAMENTS OF THE KNEE. V. Putti. *La Chirurgia degli organi di movimento*, February, 1920.

Cases of arthroplasty are not uncommon in which the lack of crucial ligaments, sacrificed during the operation, interferes greatly with the stability of the knee. The author had occasion to find this instability of the knee joint

repeatedly after arthroplasty. He has tried for sometime to remedy the defect by a reconstruction of the crucial ligament.

He reports two cases of this kind.

The first case was that of a boy 14 years in which the knee had ankylosed in a position of 110 degrees flexion following a severe articular infection. The especially favorable condition called for arthroplasty even in a patient as young as this but following the operation instability of the knee caused the author to undertake the operation for reconstruction of the crucial ligaments. This was done by means of a tunnel drilled from the external and posterior part of the external condyle of the femur to the antero-internal part of the condyle of the tibia paralleling the course of the anterior crucial ligament. Into this bone a piece of tendon, mobilized from the semitendonosis was introduced and fastened with silk to the tibia and femur.

The post operative result was satisfactory but active mobilization was not insisted upon because the patient developed a hyper-sensitiveness to motion. Nevertheless, he gained a good deal of stability in the knee joint.

The result of the second case was even more striking. It concerned a Captain with ankylosis of the knee following shrapnel wound on whom an arthroplasty of the knee was performed with free flap interposition. He showed subsequently a certain degree of antero-posterior motion of the knee although the functional result of the arthroplasty was satisfactory, as it amounted to a range of motion of 90 degrees. The reconstruction of the anterior crucial ligament was carried out in a similar way except that a small screw was used to fasten to the end of the tendon.

Five months after operation the condition of the joint was as follows:

Active flexion 60 degrees, extension complete, moveable patella, well functionating quadriceps. All signs of lateral motion and of sagittal motion had disappeared.

This operation, therefore fulfilled its purpose. Refering to an operation carried out for the same purpose by Hey-Groves, the author believes that his operation is incomplete and will obtain its object only in cases in which there is an isolated lesion of the crucial ligament. The author also considers seriously the advisability of reconstructing the lateral ligaments of the knee in a similar manner, namely, by free tendon attached to the condyles of the femur and tibia on either side of the knee.—*A. Steindler, Iowa City, Ia.*

THE END RESULTS IN PARTIAL AMPUTATIONS OF THE FOOT. S. T. Irwin, Belfast. *British Journal of Surgery*, January, 1920.

These observations are the result of experience during work in the Limbless Department of the Ulster Volunteer Force Hospital, Belfast. The author has been particularly struck by the difficulties in fitting cases of partial amputation of the foot; by the apparent impossibility of giving such patients even a moderately useful appliance; and by the frequent necessity for repairs and readjustment.

In regard to amputation of the toes he says it is always advisable to retain the great toe, if possible, and it is better surgery to excise a joint, in hammer

toe for instance and to otherwise relieve painful conditions, than to amputate even in the four outer toes. Operations for hallux valgus and hallux rigidus, though giving excellent results in civil practice, were disappointing when done for a soldier. A tender scar over the metatarsal head in amputation of the great toe often caused spasmodic inversion of the foot and prolonged disability.

Of all amputations in the lower limb none give more disappointing results, in regard to function, than partial amputations of the foot. They should never be done as a definite operation where limb fitting and suitability for employment are the determining factors in the choice of operation. The main objection is the shortening of the anterior pillar of the antero-posterior arch and the consequent results which are loss of muscular equilibrium producing deformities of equinus and varus. Difficulty is also found in supplying suitable appliances for such amputations. The elaborate fittings invented in France and Germany, according to the English author, have been uniformly unsuccessful. In Lisfranc's operation the weight is born on the outer border of the foot, the inner edge held up mainly by action of the tibialis anticus which stands out as a rigid cord drawing the cuboid inwards. The foot becomes painful in walking and rigid from spastic contraction of the tibial and peroneal muscles. The os calcis finally becomes drawn up and the weight bearing cuboid has a painful bunion overlying it. In Chopart's amputation the functional result is not as good as in Lisfranc's. After walking or standing the ankle joint first becomes painful and because there are no anterior muscular attachments the front of the os calcis and head of the astragalus rotate downwards carrying with them the scar which eventually becomes the bearing surface directly under the ankle joint the heel being drawn up behind. These secondary disabilities and deformities resulting from partial amputations are better corrected by completely amputating the foot than by corrective measures such as cutting the tendo Achilles, fixation of extensor tendons or ankylosis of the ankle.

Of the various operations and modifications of the operations through the ankle joint the author is most enthusiastic over that of Syme. From the functional standpoint he places it even higher in the scale than that of Lisfranc or an amputation at the junction of the middle and lower third of the leg which he says indicates that the ideal performance of this operation (Syme) leaves a stump which is, from the point of view of function, as nearly perfect as possible. It gives a complete and permanent bearing; there is a long lever for the activation of the artificial limb and the provision of perfect stability; and the presence of the natural knee gives almost, if not indeed quite, perfect gait. His only criticism is that the artificial ankle, owing to the side bars, is rather bulky.

A graphic representation of capacity for work in partial amputations of the foot is a valuable feature of the paper.—*E. E. Hobley, Iowa City.*

THE USE OF BEEF-BONE SCREWS IN FRACTURES AND BONE TRANSPLANTATION. By M. S. Henderson, M. D., Rochester, Minn. *The Journal A. M. A.*, Vol. 74, No. 11, March 13, 1920.

Bone grafting has become established in surgical practice as firmly as the more simple operation of skin grafting, and it has been found that the auto-

genous graft is the best. Practically all failures can be definitely attributed to technical errors, such as too small a graft, infection or inadequate fixed bony approximation of the graft to the fragments.

From a purely theoretical point of view, screws made from the bone of the patient, such as the bone pegs advocated by Albee, would be better than beef-bone screws. The theory, when put into practice has so many objections, such as making the screws or pegs fit properly, and the extra amount of bone used, that beef-bone screws are to be preferred. The question of whether the beef bone is suitable for a graft does not enter into this discussion, for all that is demanded of the screws is that they provide fixation of the autogenous graft to the fragments. They are usually absorbed completely within six months to a year.

Fresh beef bone is obtained usually from the tibia, the joint ends are sawed off, and the shaft is boiled for 1½ hours to remove the tissue and the marrow. The shaft is sawed into pieces 3¾, 2⅜ and 1¼ inches long for the large, medium and small size of screws, respectively. The medium sized screw is of aid in many situations, and many more of these are used than of either the large or the small screws. The sizes used are standard, and in mechanical terms the large screws are known as 5/16 by 18, the medium size as 10 by 24, and the small as 6 by 32. The lengths adopted are arbitrary and may be varied to suit the needs of the case. The pieces are sawed lengthwise into strips; the width varies according to the diameter of the screw to be made. The strips are roughly sized in the vise by filing, and are then turned to the proper size, pointed, and the head rounded in the lathe. These finished blanks are placed, for one half hour in petrolatum brought to the melting point in a double boiler, in order to replace to some extent the natural oils removed by the boiling. This renders the bone a little less brittle and less likely to crumble when being threaded. The heat must not be extreme or the bone will be overheated and rendered almost chalky.

The blanks are placed in the lathe and threaded by using a standard machine screw die. Petrolatum is freely used on the die while the threads are being cut. The large blank is threaded with a standard 5/16 inch by 18 die. The thread is 5/16 inch long and is flattened on two sides to ¼ inch in thickness to fit a special wrench. The large screw when finished is ordinarily 3½ inches long, but this may be varied. The medium sized blank is finished into a screw 19/100 inch in diameter and 2¼ inches in length. A little more care is necessary in putting the threads on this size than on the large screw, and we have found it necessary to step down the threads by using three dies: 12 by 24, 11 by 24, and 10 by 24. The small blank is for a screw 14/100 inch in diameter and 1⅛ inches long. It is necessary to step down the threads for this screw as follows: 8 by 32, 7 by 32 to 6 by 32. The heads of the two smaller screws are ¼ inch long and ¼ inch in diameter to allow for hexagonal shaping to a 3/16 inch standard. These fit a specially made socket wrench fitted to the end of a small brace. When the screws are received from the machine shop they are thoroughly scrubbed with soap and water and boiled in water for thirty minutes. They are then kept in the instrument case and boiled as required, just as any instrument is boiled. The screws are cheap, easily made and well tolerated by bone. The

one objection to them is that they are brittle and will not withstand any amount of stress, particularly if there is any torsion with the strain.

Even though the beef-bone screws are well made, they cannot be successfully used unless there are at hand the proper instruments for placing them. It must be remembered that they will withstand very little twisting force, and if they bind when being screwed in they will break. For the large size, 5/16 by 18, a special socket wrench is used. The large screws are used only in situations such as the head of the femur or the condyle of the femur. If not passed through any cortical bone, they are of sufficient strength to make their own threads in the soft bone, and the drill hole bored by a 9/32 inch twist drill does not need to be tapped. Since the medium sized screws, 10 by 24, and the small screws, 6 by 32, have a hexagonal head of the same size, the same wrench fits the two. For the medium sized screw the holes in the graft and fragment are bored by No. 17 twist drill and the hole is tapped by a 10/24 tap. For the small screw the hole is drilled by a No. 29 twist drill and the hole tapped by a 6/32 tap. The drill can be used on the electric motor or the hand drill. The tapping must be carefully done by hand. Handles of different styles for the wrench and taps will be found convenient for the different situations. If the subcutaneous structures are scanty, the heads of the bone screws may be removed either by bone-biting forceps or a Gigli saw.

In recent spiral or oblique fractures of the long bones, recent fractures of the neck of the femur, of the olecranon process and in certain fractures of the patella, the screws are an excellent means of obtaining coaptation of the fragments. They are a splendid means of fastening the bone grafts to the spinous processes, as is necessary in the operation advanced by Albee for tuberculosis of the spine, and are apparently the only means by which proper bony approximation can be assured. They are not so ideal in delayed union or for ununited fractures. In fractures of these two groups, it is better to accept no compromise but to employ a large graft so that when the operation is completed there is from 20 to 25 per cent. more bone in the fractured region than is normal.

If the roentgen ray discloses very marked oseoporosis of the fragments, exercises should be instituted prior to operation, regardless of the fracture, because it is only by this means that the osteoporosis will be overcome.

The technic of the inlay graft will not permit the placing of a very broad piece in the fragments. On account of failure and accidents with the ordinary intramedullary and inlay grafts, and the belief that it is most important to place more bone in the fractured area than is normally there, it has been the author's custom to proceed as follows:

The bond ends are carefully freshened so that as broad an area of their surface as possible will be in firm contact. The medullary cavity in each fragment should be opened. From one fifth to one-fourth of the entire thickness of the bone from each fragment on one side is removed for a goodly distance above and below the fracture. This should not remove the entire cortical wall. The graft, which is a piece of healthy bone from the tibia or the entire thickness of the fibula, flattened on one side, is greater in thickness than the amount of bone removed from the fragments, and is placed against their freshened surfaces, the ends of which are firm apposition and the medullary cavities in line. It is held in place by two or more beef-bone screws through the graft and through the

remains of the proximal cortex and the opposite cortex of each fragment.—*Leo. C. Donnelly, Detroit.*

FRACTURES OF THE PELVIS. William John Ryan, M. D., Philadelphia. *Annals of Surgery*, March, 1920.

The author reports 25 cases and he cites 202 cases collected from the literature. He says this serious injury is much more common than generally supposed. From the mechanical and anatomical standpoint the configuration of the pelvic ring is weakest at five points, viz: at or a little external to the sacro-ilias synchondrosis; at the symphisis pubis; and midway between the symphisis pubis and the acetabulum.

Clinical effects of fractures are considered with reference to the various functions of the pelvis which are: 1. Weight bearing between the vertebral column and the lower extremity.

2. A means of providing motion of the trunk on the lower limbs and affording attachment of muscles governing such motion.

3. A bony attachment for the abdominal and pelvic viscera.

Morris in Piersol's Anatomy is referred to in describing the mechanics of the various arches of the pelvis as explaining why severe direct violence applied to the pelvis will result in fracture of the horizontal or descending rami of the pubis, the rami of the ischium, and of the ilia external to the sacro-iliac joint.

In the author's series of 25 cases there were seven deaths, a mortality of 28%. The cases which died had severe complicating injuries. There were 13 cases of fracture of the pubis, eight of the ilium, one of the body of the right ischium, one of the body of the left ischium, one of both tuber ischii, and one of the anterior superior spine.

The most common symptom was pain increased by pressure exerted simultaneously on both hips. Crepitus was noted three times but should not be looked for. Always catheterize; if bloody urine is found determine whether rupture of urethra or rupture of bladder. Meet the operative indications found. If the fracture is one of the ilium with or without sacro-iliac joint involvement a plaster cast should be applied around the pelvis. If pubis or ischium is involved a wide adhesive swathe is used. In either case a Bradford frame elevated above the bed for facility of affording attention is indicated.

Of the cases that recovered 11 were traced at the end of a year or more. Seven were normal, one had normal function but occasional pains in the region of the sacrum; 1 had a limp due to shortening of limb fractured at same time as pelvic fracture; one had vague pains through the pelvis though examination was negative; one who had a possible rupture of urethra also had an enlarged prostate accounting for symptoms, improved under treatment and drifted from observation.—*E. E. Hobly, Iowa City.*

ADEQUATE REDUCTION AND CARE IN COLLE'S FRACTURE. NEW METHODS. Frederick J. Cotton, Boston. *Boston Medical and Surgical Journal*, December 4, 1919.

The main cause for unsatisfactory results in the reduction of Colle's fracture is the backward rocking of the distal fragment, which makes proper reduction

of the ulna impossible, which luxation, rather than the fracture of the radius, is the cause of the disability. When the wrist is broken, there is a rotation backward of the hand about the ulnar head as a fixed point, and which tears the ulnar ligaments loose and also breaks the radius and gives the altered angle of the articulating surfaces.

If the hand is displaced in extension, reduce it in flexion, or if it is displaced in rotation-supination about the ulnar head, reduce it in pronation. The whole point is—after the obvious displacement of the radius is corrected, then carry the hand about the ulnar head as a fixed point into pronation and flexion. In the old cases osteotomy is done and the procedure followed as in a fresh case.—*Custis Lee Hall, Washington, D. C.*

CONGENITAL SYPHILIS IN AN ORTHOPAEDIC CLINIC. P. W. Roberts, M. D. *The American Journal of Syphilis*, October, 1919.

The author reports a series of 226 cases which he considered to be congenital syphilis and which had been diagnosed as follows:

Eighty-one cases of Joint Tuberculosis, 14 cases as Osteomyelitis of the bones, 5 cases as Torticollis, 12 cases as Myotonia, 5 cases as Tuberculous Adenitis, 7 cases as Myositis with sacro-iliac strain, 24 cases as Arthritis, 8 cases as disease of the carpus or tarsus, 16 cases as Chronic Headache, 10 cases as Osteochrondritis of the Hip, 1 case as Lateral Curvature of the Spine, 1 case as Lymphangitis.

Of the 81 joint cases Wasserman test was made in 47 showing 11 weakly positive and 36 negative result with alcoholic extracts. With cholesterinized antigens, however, they tested 33 positive from 1 plus to 4 plus and 14 negatives.

While the author does not assert that these cases were syphilis he maintains that they present some evidence of inherited taint and they all responded to anti-luetic therapy. The most interesting results were those obtained in lesions of the spine and which before had been diagnosed as tuberculosis of the spine.

All these cases showed perceptible improvement in from 2 to 3 weeks and most of the cases where large articulations were infected became free from symptoms in 2 to 6 months. The author does not consider that disappearance of symptoms is tantamount to cure but proceeds to continue the treatment for at least a year after all evidence of active disease has ceased.

It is the contention of the author that he has demonstrated by this study that chronic articular lesions due to invasion by either tubercle bacilli or by trepanoma pallida produce the same clinical picture. He also emphasizes the necessity of eliminating the diagnosis of congenital syphilis by at least five to six weeks of vigorous anti-luetic treatment.

Of special interest is the author's series of 14 cases of osteomyelitis. In one of these cases, which had been operated four times during a period of six years,

the symptoms all disappeared and the sinus healed after six weeks of mixed treatment. Other cases showed similar improvement.

He also takes up the group of osteochrondritis of the hip, known as Legg Perthe's disease. Not only was there rapid subsidence of acute symptoms but of eight bloods tested with cholesterinized antigents, one gave 4 plus reaction, one 3 plus, two 2 plus and three 1 plus.

It is the conclusion of the author that many of the syphilic infections pass unrecognized because of the traditional diagnosis of tuberculosis in almost all destructive lesions of the spine and large joints.—*A. Steindler, Iowa City, Iowa.*

THE TREATMENT OF CENTRAL LUXATION OF THE FEMUR. By Royal Whitman, M. D., New York, N. Y. *Annals of Surgery*, Vol. LXXI, January, 1920, No. 1.

This paper is practically limited to the consideration of fracture of the base of the acetabulum with penetration of the femoral head, uncomplicated by extensive fracture of the pelvis or injury of its contents; in other words, to the class of cases in which the chief concern is the functional result as affected by treatment.

The prominence of the trochanter is lost. The limb is somewhat flexed, adducted, and slightly shortened. There is a fair range of flexion and extension, but rotation is very limited, and abduction is almost completely restricted because of the contact of the trochanter with the acetabular rim.

When weight bearing is attempted, pain is increased and is reflected down the inner and posterior region of the thigh, caused apparently by pressure on the nerves passing in the neighborhood of the displaced femoral head.

The practical indication in treatment is to assure a sufficient range of a abduction, which from the functional standpoint is of far greater importance than the reduction of the dislocation although the one is necessarily dependent upon the other.

The head of the femur having been driven inward, the trochanter is apposed to the acetabular rim when the limb is in the line of the body. This furnishes a point of resistance or fulcrum against which the leverage of the extended limb may be utilized to withdraw the head of the femur from the pelvis.

The patient, having been anaesthetized, is placed on a pelvic support, provided with a perineal bar. The sound limb is then abducted to the normal limit to fix the pelvis. The other limb in the extended attitude and under manual traction is then gradually and forcibly abducted, if practicable, to the normal limit, which should indicate the complete withdrawal of the head from the pelvis, and in this attitude a plaster spica is applied extending from the line of the nipples to the knee.

It is possible, if the patient were treated soon after the injury, that the displaced acetabular floor might be reduced somewhat by pressure through the vagina or rectum. The plaster spica must be retained for several months, locomotion being permitted as soon as it does not increase the discomfort, since displacement is impossible in the abducted attitude. After the support is removed, the limb must be passively abducted to the full limit at frequent intervals, until the patient has regained voluntary control of this movement.

This treatment is designed primarily for uncomplicated cases, in which natural mechanics may be utilized. If the pelvis were so fractured that effective leverage could not be employed because of the lack of a resistant fulcrum, one would attempt to secure a sufficient degree of abduction by direct manual traction combined with gentle lateral movement of the limb.

The range of abduction is dependent upon the distance between the trochanter and the acetabular rim, and it is determined by their apposition. Complete abduction indicates complete disengagement of the head; and a limited range a corresponding incompleteness of reduction.

If the resistance has become so great that the head cannot be withdrawn by natural leverage, an osteotomy below the trochanter is indicated, since the purpose of treatment is to secure and to retain a sufficient range of abduction for functional requirements.

Intrapelvic exploration would seem to be a doubtful expedient. In recent cases the displacement should be easily reduced by the abduction method, while if of long standing the prospect of improved function would hardly justify the risk.

If a sufficient range of abduction is attained by the manipulation its retention can be assured by fixing the limb for a sufficient time to permit the accommodative changes in the tissues. This time should vary with the duration of the displacement, and the quality of the after-treatment at command, and fixation should again be employed if the range of abduction progressively lessens.

This latest application of the principles of the abduction treatment illustrates its wide range of practical adaptability. Nearly all of the so called disabling contusions about the hip are in reality fractures of the femur or of the pelvis, and either because of uncorrected deformity or as an instinctive adaptation to weakness and pain, the limb usually becomes flexed and adducted.

In all obscure injuries in this region, the abduction method might be applied with advantage as for fracture of the neck of the femur since it is the only efficient means of adjusting and fixing the fragments if thus broken, while if the pelvis is injured, restraint of the limb is required for effective splinting. The abduction treatment has the further advantage that immediate correction of deformity, the first essential of success, is supplemented by an after care conducted with a definite aim and guided by physical signs that indicate the progress of reconstruction upon which functional recovery depends.—*Leo C. Donnelly, Detroit.*

STIFF KNEE IN RELATION TO COMPOUND FRACTURE OF FEMUR. Paul Bernard Roth. *B. M. J.*, 1919, Vol. 3064, p. 395.

In commenting on the article by Captain Alexander, issue is taken by the writer to the point that stiff knee resulting from compound fracture of the femur is due to shortening of the quadriceps and adhesions resulting from disuse and sepsis. It is Roth's belief that stiff knee is due to the method of treatment. He asserts that if treated with a straight Thomas splint the stiffness may result as Capt. Alexander explains: that, however, if a modified Thomas splint be used, with the added lower half of a Watkins-Williams and

extension applied direct to the fragment by means of Pearson tongs, the knee may be flexed and the quadriceps exercised daily. With this latter procedure he regards the occasion of a stiff knee resulting to be a disgrace to the surgeon.

He further takes exception to the statement that all compound fractures of the femur cause knee infection, and questions how it would be possible for this to occur in the case of compound fracture in the upper third of the femur.

Mr. Roth prefers chloroform or ether to gas, as more thorough relaxation may be obtained and there is less danger of damage to quadriceps and knee-ligaments in wrenching of the knee.—*J. E. M. Thomson, Lincoln.*

FURTHER OBSERVATIONS ON THE CONSERVATIVE TREATMENT OF SARCOMA OF THE LONG BONES. William B. Coley, New York. *Annals of Surgery*, December, 1919.

Certain considerations of the condition, following a study of 250 cases, with conservative measures in view, convince the author that radical surgical procedures, such as amputations, are often unnecessary. First the element of pain of a deep boring character, steadily increasing in severity, is the earliest symptom of the disease. In case of doubt the exploratory operation is advised, but the clinical course and X-ray picture render diagnosis practically certain. The author believes operation for diagnostic purposes does not cause any great degree of risk of metastases. Difficulty is encountered in establishing a definite diagnosis between giant cell sarcoma of the non-malignant type and the malignant forms of sarcoma. In forty cases of supposed giant cell sarcoma, eight cases died of metastases.

In dealing with periosteal tumors the treatment is of course, radical, even prompt amputation very early in the disease has failed to prevent fatal termination. A plea is made for conservative treatment even in this type and the use of radium locally, sometimes placed in the operative wound next the bone, and the toxin treatment, consisting of mixed toxins of erysipelas and bacillus prodigiosus. Giant cell sarcoma of the long bones, the author believes, is more rare than is usually supposed. In this series of cases it has been found possible to save the limb in 17 cases by the use of toxins alone 4 by a combination of toxin and radium treatment, 2 by curetting. Of the 17 cases in which the limb was saved, 6 were of periosteal origin and 12 of central origin. An excellent article with splendid case reports and illustrations.—*Custis Lee Hall, Washington, D. C.*